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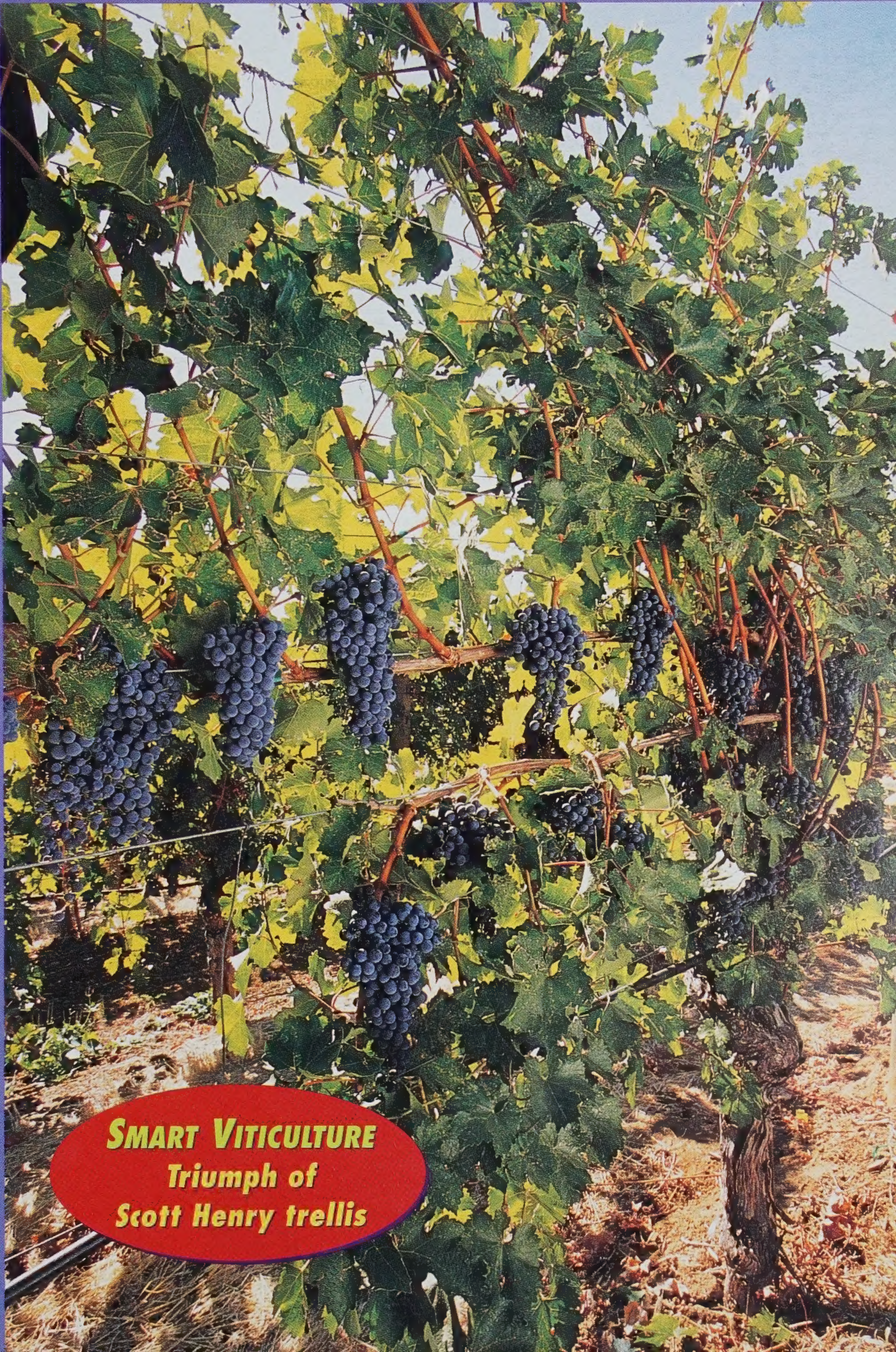

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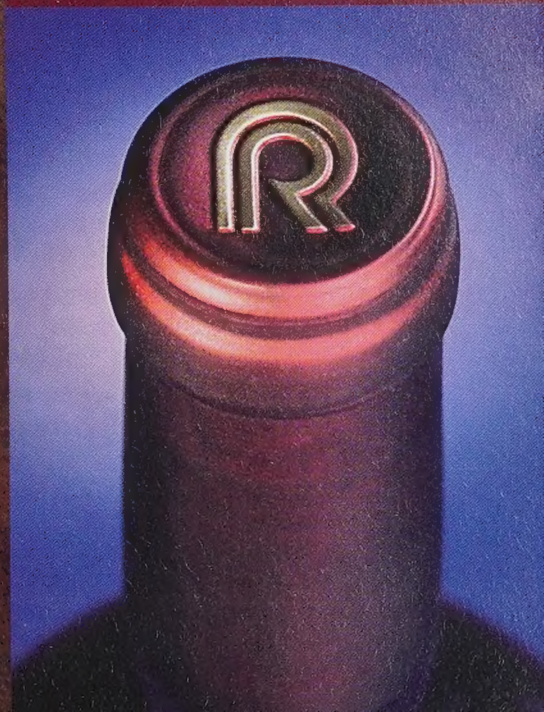

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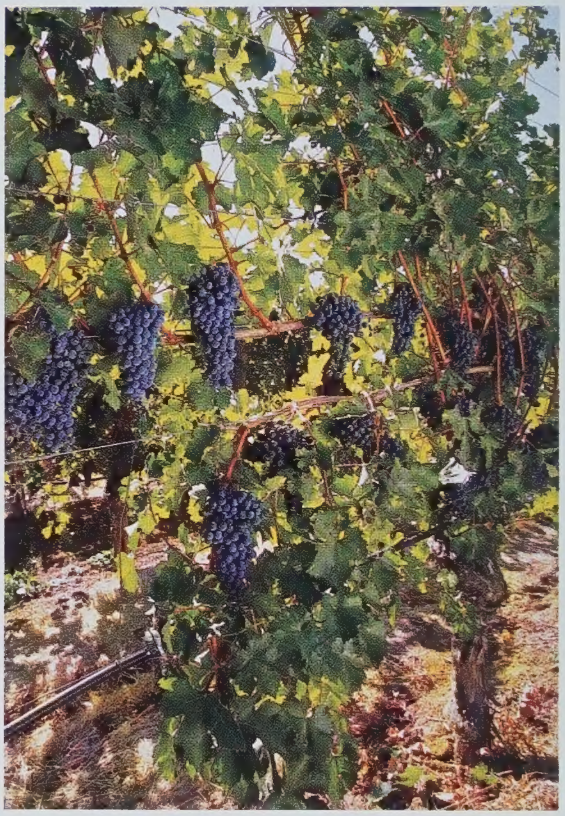

5 Cabernet Franc on Scott Henry trellis at Robert Young Vineyard, Geyserville, CA. Photo by Fred Lyon.

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"To stimulate continuing improvement in the wine industry."

Triumph of Scott Henry trellis

BY Dr. Richard Smart

Many readers will know that the Scott Henry trellis is named after its inventor, one Scott Henry of Umpqua Valley, Oregon. Scott and his wife Sylvia started the Henry Estate winery/vineyard where the trellis system was developed.

The story of how Scott developed the trellis system that bears his name is told in the book *Sunlight into Wine.* Faced with high vigor, bunch rot, and poor ripening, Scott was anxious to try canopy division to overcome the problems, but he didn't want to implement the lyre system. So he tried dividing the canopy vertically, and the new system was born.

During the early years of my consulting work, the Scott Henry trellis was the one I most frequently recommended. Though the Smart Dyson trellis has since become my most common recommendation, I still think highly of the Scott Henry. The reasons are straightforward. It is easy to retrofit, and well-suited to vineyards of moderate vigor with vine rows spaced as close as seven feet apart.

The Scott Henry trellis is easy to mechanically harvest and also easy to shoot-position once growers learn the importance of correct timing. Yields are typically about 30% higher than for vertical shoot positioning (VSP), for fruit of similar or improved ripeness. The canopy is more open, wine quality is improved, and bunch rot is reduced.

The Scott Henry is now used all over the world. Strangely, it is little used in Oregon, for reasons I do not understand. It certainly is well suited there! Application in California has also been limited, again for reasons I do not always comprehend.

However, growers in many other countries have benefited from using the system. It has also now found its way into one of the world's most prestigious wine books, the 2001 edition of *The World Atlas of Wine* by Hugh Johnson and Jancis Robinson.

How the Scott Henry trellis works

The original form of the Scott Henry was cane-pruned. The vines have four canes, two on the top fruiting wire, and two on the lower fruiting wire. The lower fruiting wire is set at about 36 to 40 inches above ground, with the top fruiting wire six to 12 inches higher and on the opposite side of the post.

Above the top fruiting wire there must be two pairs of movable foliage wires, and at least 24 to 30 inches of post. This holds the foliage up. Only one moveable wire is used to train foliage downward.

Details of shoot positioning can be found in *Sunlight into Wine*. The shoots growing from the upper canes are separated from those on the lower ones about two weeks before bloom. Don't do it too early, or shoots will break. Don't do it too late, or tendrils bind the canopy together.

Shoots from the top cane are trained upward between the top pair of foliage wires. They will need to be trimmed when about three feet long. Shoots from the bottom canes are trained downward, and will reach the vineyard floor. They do not need to be trimmed, and the tractor driving over them controls their length. Some growers do trim them, but they should also be three feet long.

Consider a vineyard with vines of moderate vigor, planted six feet apart in the row, and with four pounds pruning weight. If this vine were pruned to 30 buds, it would be out of balance.

The normal rule of thumb is around 14 buds per pound of pruning weight to achieve vine balance, so almost 60 buds would be required. This would mean a shoot density of around 10 shoots per foot, double the ideal of five shoots per foot.

If trained to vertical shoot positioning, with all shoots upward, the canopy would be either too crowded (if pruned to the correct bud number of 60) or out of balance (and still crowded because of high shoot vigor) if pruned to 30 buds.

Conversion to a divided canopy like the Scott Henry is the solution. Prune the vine to 60 buds, and train half the shoots up and half down. The canopy surface area is almost doubled, the vine will be in balance, and the canopy will be open with good leaf and fruit exposure. If all the extra crop is not required, it may be thinned later.

Alexander Valley experience with Scott Henry

Jim Young of Alexander Valley is convinced that use of the Scott Henry trellis has made the vineyard operation more successful at Robert Young Vineyard, (Geyserville, CA). Jim farms about 320 acres of vineyard, of which about 200 acres are trellised to Scott Henry, and the remainder will be converted in the future.

Vine spacing at Robert Young Vineyard includes: some Chardonnay with six feet between vine rows and five feet between vines (6x5), Sauvignon Blanc is 6x8, various other varieties are 6x6, and red grape vines on hillsides are 8x6.

Because of phylloxera, much of the vineyard has been replanted. Some of the vines are pruned to four canes with Scott Henry, some to three.

Jim learned about Scott Henry from reading articles in *PWV* and the book *Sunlight into Wine.* He began trials with the system in the early 1990s and liked what he saw. The system overcame vigor problems and delivered increased yields. The canopies were more open, with good fruit exposure, and less bunch rot.

Jim set about installing the Scott Henry trellis on most of the ranch. There were no problems training workers, and Jim finds that no more passes for shoot positioning are required through the vineyard than for VSP. (My experience is the same.)

"Generally, we turn the canes down between early bloom and beebee sizing of the grapes," explains Young. "In a rainy bloom period, we would turn the canes down sooner. We start with Chardonnay and finish with Cabernet Sauvignon."

The Scott Henry trellis has been installed on many varieties, including Chardonnay, Pinot Blanc, Viognier, Riesling, Sauvignon Blanc, Cabernet Franc, Merlot, Cabernet Sauvignon, and Syrah.

The majority of the fruit is sold to other wineries. Twenty tons of Chardonnay are processed for Robert Young Estate Winery. Production of the Robert Young Estate Winery Scion red table wine blend of Cabernet Sauvignon, Merlot, and Cabernet Franc has grown from 500 cases to 1,500 cases per year.

Rot problems have been minimized since conversion to Scott Henry, especially for Riesling, which can now withstand rainfall better than it could with the previous trellis. Riesling yields have improved by about 30% from seven tons per acre to almost 10 tons per acre. This amounts to about 16 pounds per vine on his 6x6 spacing (1,210 vines/acre). Other varieties have also improved yield by about 30%.

With average grape prices at $2,400 per ton, an extra 2.5 tons per acre means $6,000 extra income per acre. Against this is set the extra cost of cane pruning in winter, which is more expensive than spur pruning. This is a small cost difference, however.

I normally estimate the extra cost of cane pruning at about $150 per acre, based on about 15 hours per acre of extra labor at $10 per hour. Then there may be at the outside (for inexperienced operators) another 10 hours per acre extra shoot positioning (or $100 per acre; I normally count on about $50 per acre).

These calculations show that extra income of about $6,000 is reduced only by extra costs of around $250 per acre maximum. Jim reports his extra costs are $450 per acre, including $50 per acre for shoot positioning labor on 6x6 plantings. One does not need a higher degree in accounting to see the extra profit to be achieved. The extra costs of installation are normally small.

I asked Jim why more growers do not use the system, and he could not explain it. Maybe they are frightened of extra labor, he suggested. He did say that some of his neighbors are trying the Smart Dyson trellis, which is working well.

Jim is very pleased with the wine quality from Scott Henry-trained vines. At this time, for his own label, he is cropping very conservatively, thinning to one bunch per shoot and evaluating the procedure as he goes along.

For the Robert Young Estate Winery Scion red wine and Chardonnay, the vines have been cropped at 10 pounds per vine. In 2001, vines producing grapes for Scion were cluster-thinned to 7.5 pounds per vine, pre-veraison in early August.

Most vines for his label are Scott Henry-trained. He has been well-rewarded, with the 1999 Robert Young Estate Winery Chardonnay listed as #4 in the *Wine Enthusiast* top 100 wines for 2001. And this from vines yielding six tons per acre!

I asked Jim about differences in fruit ripening between the upper and lower canopies on Scott Henry. The maximum difference he has seen is 0.5° Brix. This is way less than he used to find on his old "sprawled" vineyards. Jim finds a row orientation of east/west is preferable, in order to reduce sunburn effects. For north-south rows he does less leafing on the west side.

Conclusion

Jim Young has proven the theory behind the Scott Henry trellis on a couple of hundred acres. Young reports more consistency in yield from year to year and that the vineyards are much more profitable.

In my experience the Smart Dyson trellis works equally as well and can be spur-pruned. Growers might ask themselves why they are not using these systems more. ■

Dr. Richard Smart, "the flying vine-doctor," is an international viticultural consultant based in Australia. He is also a visiting professor of viticulture at Cal Poly, San Luis Obispo, CA. Contact him by e-mail: vinedoctor@compuserve.com. Read about Dr. Smart's business, including his consulting schedule, educational wine tours, and seminars, at his home page, www.smartvit.com.au. He visits America frequently and his consulting schedule is arranged by Vinquiry in Windsor, CA, tel: 707/838-6312 and www.vinquiry.com.

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Balanced soil fertility management in wine grape vineyards

**BY Stan Grant, Vineyard Consultant
Progressive Viticulture**

Imbalances in the supply of nutrients can cause nutrient disorders (deficiencies, excesses, and toxicities) in grapevines. They can also decrease vineyard soil fertility, structure, and tilth, making a less hospitable environment for vines and cover crops.

The physical, chemical, and biological characteristics of soils often vary across a vineyard. Under cultivation, the fertility and tilth of some soils will decline more rapidly than others, which compromises uniformity in fruit development, complicates vineyard management, and increases operational costs.

Grape quality suffers, as do vineyard income and relations with buyers. These factors make it apparent that maintenance of a balanced nutrient supply is critical to sustained vineyard profitability.

Mineral nutrients are chemical ions required by plants for growth and development. They occur naturally in soils. Some mineral nutrients are required by grapevines in relatively large amounts, others in small amounts. These are the macronutrients and micronutrients, respectively (Table I). Macronutrients include nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S). Important micronutrients[A] are boron (B), zinc (Zn), manganese (Mn), iron (Fe), and copper (Cu).

[[A]Other micronutrients of higher plants (excluding mosses, ferns, and other primitive plant forms) include molybdenum (Mo) and chloride (Cl), but no deficiencies of these nutrients have been observed in grapevines. Chloride toxicity is a problem associated with many saline soils.]

Fertility refers to a soil's ability to supply mineral nutrients. A limited mineral nutrient supply causes grapevine deficiencies that include damaged tissues (rendering specific foliar symptoms), restricted vine growth, limited fruit production, delayed fruit maturation, diminished fruit quality, and increased susceptibility to various pests and diseases.

An excessive nutrient supply in the soil is also detrimental to balanced vine growth and fruit quality, and sometimes causes toxicity in plant tissues. Therefore, the basic goal of vineyard soil fertility management is to provide a supply of mineral nutrients that avoids both of these extreme conditions.

Historical approaches to managing vineyard soil fertility

The earliest methods for maintaining vineyard soil fertility did not consider the supply of individual mineral plant nutrients. Instead the focus was on maintenance of general soil fertility and health with soil amendments. Soil amendments are organic materials (usually agricultural wastes) and mined mineral materials.

Soil amendments continue to have a significant role in sustaining soil viability and long-term vineyard profitability. However, they often fail to provide sufficient nutrients to avoid grapevine deficiencies in soils with very low supplies of available nutrients or in soils with the capacity to absorb and adsorb large quantities of applied nutrients.

In recent years, soil amendment failures have increased as more vineyards are developed on marginal lands and many vineyard managers shun synthetic fertilizer inputs for philosophical, financial, or other reasons.

In the 1950s, after synthetic fertilizers became widely available, grapegrowers had the ability to target specific nutrient elements in their management of soil fertility. These fertilizers contained ample nutrients. Concentrated, large-dose applications can saturate a soil's nutrient absorption capacity, leaving excess nutrients available for uptake by plant roots.

Two large-dose application technologies, broadcast and band, were developed to make the most efficient use of synthetic fertilizers in the 1950s. Banded applications (shanked when the fertilizer band is placed below the soil surface) are appropriate for nutrients that are strongly adsorbed by soils. Broadcast applications are appropriate for all other nutrients.

In recent years, application of liquid, dissolved, or suspended fertilizer in irrigation water has become a common practice in vineyards. This technology, called fertigation, allows great flexibility in the timing of fertilizer applications.[3,48] In addition, it often increases the rate of nutrient uptake and the predictability of vine responses to fertilization compared to broadcast or banded applications.[3,30,41] Therefore, it is generally the most efficient fertilizer application method.

Avoidance of deficiencies is possible and correction of severe deficiencies is achievable with these fertilization technologies. A single nutrient approach to vineyard soil fertility management developed from them because they readily lent themselves to correction of specific mineral nutrient problems. The single nutrient approach was further refined with advances in laboratory testing of soils and plant tissues, and calibration of yield and growth responses to test values.

Balanced grapevine mineral nutrition

As effective as the single nutrient approach is for avoiding deficiencies, it does not easily lend itself to the maintenance of a balanced supply of plant nutrients in the soil. Rather, supplies of the applied nutrient in treated soil are usually excessive for a time immediately after fertilizer application, sometimes causing large changes in pH, spikes in salinity, and large shifts in soil chemical equilibria.[3,48]

These changes in the soil chemical environment are sometimes antagonistic to the uptake of other nutrients, creating nutrient imbalances.[1,6,48] They also are unfavorable for roots and certain beneficial soil microorganisms.

After a time (up to several weeks), the level of fertilizer nutrient decreases, most adverse side effects diminish, and the vine draws upon healthy soil with an adequate nutrient supply. Eventually, with continued removal from the soil by plants and leaching, and without intervention by vineyard management, the nutrient may become so depleted as to impair vine functions. Thus, the supply of nutrients is again out of balance.

Obviously, at no time during the growing season do grapevines take up only a single mineral nutrient. Rather, they take several mineral nutrients at rates that vary according to environmental conditions including nutrient availability in the soil, and the changing demands of their developing tissues and metabolic activity.[48]

Optimized soil fertility management must consider (and whenever possible anticipate) the changing needs of grapevines for all mineral nutrients.

Most vineyards are initially developed with an unbalanced supply of soil mineral nutrients, in which levels of one or more nutrients are low or high compared to the rest. There are several causes for these imbalances:

1) Mineral composition of the rocks that evolve into soil is not proportionate to vine mineral nutrient needs.

2) Soil forming processes release minerals from weathered rock at varying rates.[1,48]

3) Soils hold some available nutrients better than others and absorb or fix some nutrients more readily than others.

4) Plants remove some nutrients in greater quantities than others, more rapidly depleting the soil supply.

5) Previous agricultural practices affect the amount of nutrients added with fertilizers, soil amendments, and irrigation water, and the amount of nutrients lost with harvested crops, eroded soil, and irrigation water that moved below the root zone.

Balanced soil fertility management strives to maintain a supply of nutrients balanced relative to one another and needs of the grapevine during particular phenological periods. In addition to balancing the supply of mineral nutrients, a balanced nutrient approach to soil fertility management should provide vineyard managers with the ability to correct moderate deficiencies in season and give partial control of vine vigor.[B]

Table I. Major mineral nutrients of grapevines, mechanism of their movement in soils, and effects of nutritional disorders.[1]

Mineral Nutrient	Mineral Nutrient Type	Principal Soil Movement Mechanism[2]	Effects of Deficiency[3]	Effects of Excess[4]
N	Macronutrient	Mass flow & diffusion	Reduced vigor, small shoots and leaves, pale foliage, reduced yield	Excess vigor, enlarged leaves, reduced bud fruitfulness, reduced fruit set, *reduced root growth*
P	Macronutrient	Diffusion	Retarded growth, reduced bud fruitfulness reduced yield, restricted foliage growth, reddened or yellowed tissues between leaf veins	*Zinc deficiency*
K	Macronutrient	Diffusion & mass flow	Leaf chlorosis & death, early leaf fall, retarded shoot growth, reduced cluster size & number, uneven ripening, increased susceptibility to frost damage	High fruit pH, *decreased magnesium uptake*
Ca	Macronutrient	Mass flow & root interception	*Restricted shoot & root growth*	*Reduced potassium & magnesium uptake*
Mg	Macronutrient	Mass flow & root interception	Yellowing at leaf edges, sometimes extending inward between main veins	Reduced potassium uptake
S	Macronutrient	Mass flow	*Uniform chlorosis, retarded plant growth, nitrogen accumulation*	*Soil acidification*
B	Micronutrient	Mass flow	Very short internodes, mottled & patched chlorosis, poor or no fruit set, shot berries, shoot tip death	Toxicity: Dark brown speckles or necrosis on edges of older leaves, cupped & wrinkled young leaves
Zn	Micronutrient	Mass flow	Distorted, mottled apical leaves; stunted shoots; poor fruit set & shoot berries	*Inhibited root growth, young leaf chlorosis*
Mn	Micronutrient	Mass flow	Chlorosis bands on basal leaves & death, decreased cold hardiness	*Tissue injury, deficiency symptoms of other nutrients*
Fe	Micronutrient	Mass flow	Interveinal, creamy chlorosis on apical leaves; stunted shoots; reduced yield	*Reduced yield*
Cu	Micronutrient	Mass flow	*Short internodes, pale color, distorted young leaves*	*Reduced vigor, inhibited root growth or root damage*

[1] Effects in italics have not been documented in California vineyards.

[2] Source: Barber (1984).

[3] Source: Christensen, et. al. (1978), Grant (1998), Marschner (1986), Mullins, et. al. (1992), Robinson (1992), Tisdale, et. al. (1985).

[4] Source: Barber (1984), Christensen, et. al. (1978), Marschner (1986), Robinson (1992), Tisdale, et. al. (1985).

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[[B] The greatest part of vigor control comes from management of soil moisture and crop level, but fertilization, especially nitrogen fertilization, interacts with these.]

Requirements of a balanced nutrient approach

A balanced nutrient approach requires knowledge of soil nutrient supply, vine nutrient demand, vineyard nutrient economy, and vine nutrient uptake capabilities. It also requires fertilizer and application technologies.

Specific knowledge of the soil nutrient supply depends on estimates of the root zone size and its available nutrient content. The size of the root zone is a function of soil conditions and the extent of active roots, which change over the course of the growing season as soil moisture from winter rains is depleted and vines become increasingly dependent on moisture from irrigation.[50]

Table II.
Nutrient content of mature fruit.[1]

Nutrient	Nutrient content (lb/ton) Average	High	Low
N	2.92	4.12	1.80
P	0.56	0.78	0.44
K	4.94	7.38	3.18
Ca	1.00	1.86	0.34
Mg	0.20	0.32	0.10

[1] Source: Mullins, et. al. (1992)

The changing and uncertain nature of root zone size greatly limits its usefulness for designing balanced nutrient fertilization programs. It does, however, indicate that broadcast and banded fertilizer applications are usually most useful early in the season, while the importance of fertigation increases as the season progresses.

Laboratory soil analyses provide a measure of available nutrients in the root zone, but analysis results are of limited use in determining the amount of fertilizer to apply because alone they do not indicate the total amount of nutrient accessible to the vines. They are, however, very useful for determining soil nutrient imbalances, such as high and low concentrations of competing ions, and the potential for nutritional disorders. They also indicate general soil chemical conditions, such as pH and salinity, which are considerations in fertilizer selection.

Grapevine demand for mineral nutrients corresponds mainly to vine biomass per acre. Obviously, a large vine biomass per acre, whether due to large vines or high vine density, will result in a larger nutrient requirement than low vine biomass.

It is the seasonal biomass — the new root, foliage, and fruit growth — that is the greatest determinant of vine nutrient demand.[8,9,10,11,33] The permanent vine biomass — the trunk, cordons, and old roots — begin the season as a source of nutrients, but they also exhibit a small demand for nutrients to be stored for the following season.

Most of the nutrients garnered by new roots and foliage stay within the vineyard and are recycled, becoming available for vine use after decomposi-

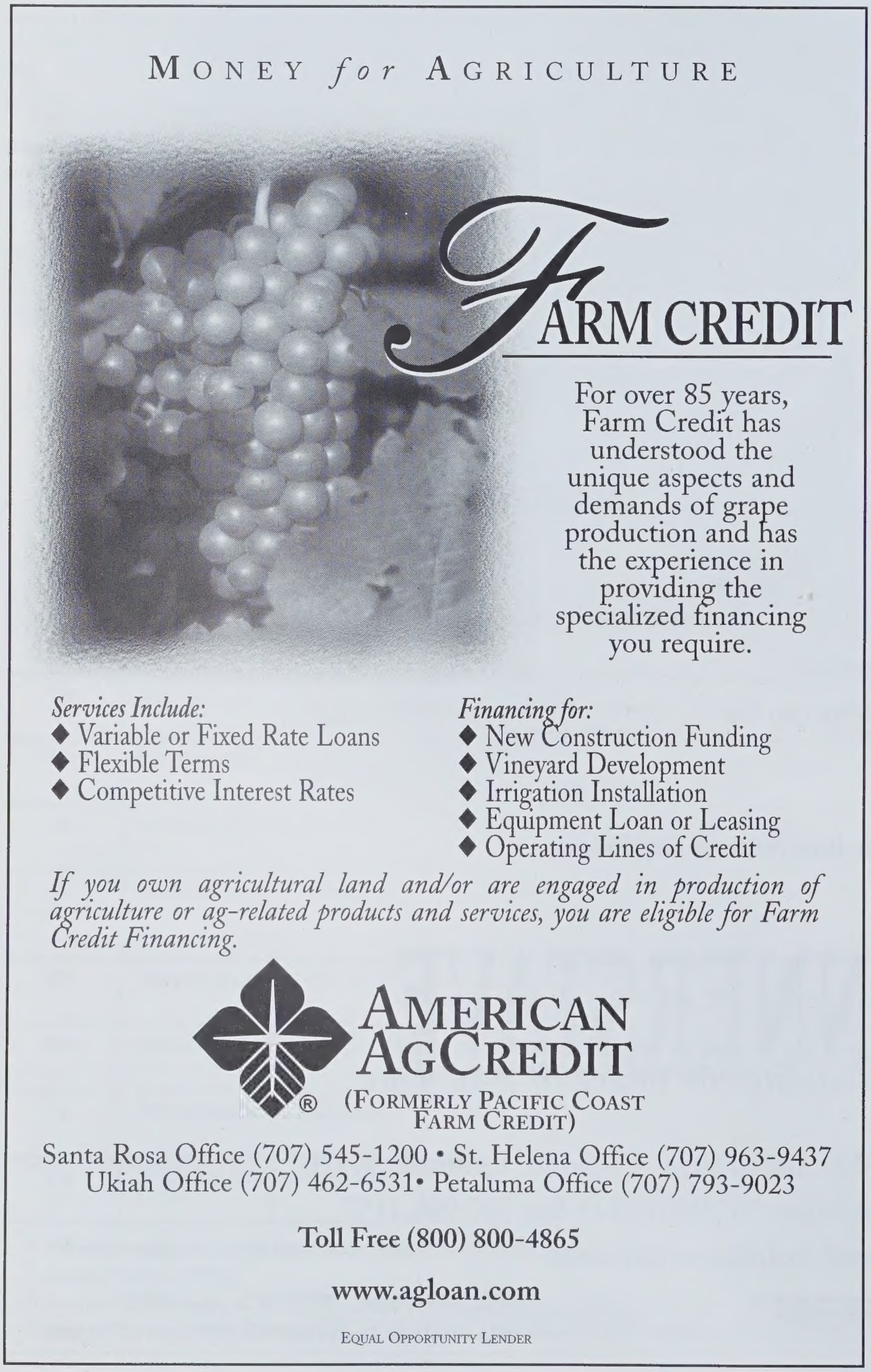
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Table III. Percent increase in nutrient content of grapevines and vegetative organs above budbreak levels, and fruit above fruit set levels during a growing season.[1]

Phenological Period	Nitrogen (N)			Phosphorus (P)			Potassium (K)			Calcium (Ca)			Magnesium (Mg)		
	Vine	Vegetation	Fruit	Vine	Vegetation	Fruit	Vine	Vegetation	Fruit	Vine	Vegetation	Fruit	Vine	Vegetation	Fruit
6-inch shoots	15	15		12	12		23	23		8	8		8	8	
Start of bloom	32	32		62	62		109	109		34	34		50	50	
End of bloom	63	57		121	112		187	166		80	76		104	96	
End of rapid shoot growth	100	70	381	186	140	398	347	204	570	151	134	327	187	154	343
Veraison	165	95	1020	274	175	989	534	202	1459	225	199	562	318	253	800
Harvest	166	67	1463	263	139	1264	597	137	2063	249	222	570	382	308	917
Post harvest	103	103		163	163		269	269		234	234		374	374	
Start of leaf fall	129	129		222	222		272	272		264	264		443	443	
End of leaf fall	80	80		103	103		134	134		61	61		163	163	

[1] Sources: Conradie (1980), Conradie (1981).

tion.[33,57] In contrast, the harvested fruit represents a net nutrient loss (Table II).[33,57]

Nutrients contained in the fruit come from the soil and stored reserves in permanent parts of both the vine and soil, both of which need to be replenished for the following season to sustain consistent vine performance. It is this loss that figures most heavily in the seasonal fertilization rates of a balanced nutrient program.

Vegetative growth of roots and foliage is steady early in the growing season, and there is a corresponding increase in demand for nutrients (Table III).[8,9,10,11,33]

Shortly before bloom, vegetative growth and nutrient demand slows, but demand for nutrients sharply increases after the fruit sets, when reproductive growth becomes rapid.[8,9,10,11,26,33] A large portion (40% to 45%) of nitrogen taken up during this time will be removed from the vineyard in the harvested fruit and some (20% to 25%) will be stored in permanent structures for use during the following growing season.[8,9,11]

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After fruit set, along with the general shifts in growth and nutrient demand, there is a change in the relative demand for specific nutrients (Table III). Instead of similarly increasing, after bloom the demand for specific nutrients diverges.

The demand for calcium and magnesium increases moderately, the demand for nitrogen and phosphorus increases more rapidly, and demand for potassium increases more dramatically.[8,9,10,11,33][C]

[[C] Post bloom nitrogen uptake representing about 70% of the seasonal requirement.]

Differences among nutrients in seasonal demand figure heavily in the scheduling of fertilizer applications.

A grapevine's ability to take up nutrients normally increases early in the season as temperatures warm, metabolic activity increases, and transpiration increases.[8,9,10,11] Early season increases in nutrient uptake correspond well with increases in mineral nutrient demand. After bloom, uptake fails to keep pace with demand and much of the needed nutrients, particularly nitrogen, phosphorus, and potassium, are remobilized and transferred from roots and shoots.[8,9,10,11,26,33,35]

Nutrient uptake is frequently limited by factors that restrict movement of nutrients in the soil and factors that limit root growth and function.[1] Common environmental factors that may limit nutrient uptake include prolonged cool temperatures early in the season, restricted soil drainage, soil compaction, and presence of soil-borne pest populations capable of damaging roots.[1,10] Until these conditions are corrected, the effectiveness of soil-applied fertilizers will be limited, as will the success of a balanced mineral nutrition program.

Table IV. Selected liquid fertilizers suitable for injection into drip irrigation systems.[1]

Name	Analysis	Type	Acidifying in Soils
Ammonium Nitrate	20-0-0	Basic	Acidifying
Urea	23-0-0	Basic	Acidifying
Urea Ammonium Nitrate or UAN-32	32-0-0	Basic	Neutral
Ammonium Polyphosphate	10-34-0	Basic	Acidifying
Ammonium Thiosulfate	12-0-0-26(S)	Basic	Acidifying
Calcium Nitrate or CN-9	9-0-0-11 (Ca)	Basic	Neutral
Calcium Ammonium Nitrate or CAN-17	17-0-0-8.8 (Ca)	Basic	Mildly acidifying
Calcium Thiosulfate or Thiocal	0-0-0-10(S)-6(Ca)	Basic	Mildly acidifying[2]
Potassium Nitrate	2.3-0-8	Basic	Neutral
Potassium Chloride	0-0-10 or 12	Basic	Neutral
Potassium Chloride	4-0-10	Basic	Neutral
Potassium Sulfate	0-0-6 or 8	Basic	Neutral
Potassium Sulfate or ESP	1-0-8-2.5(S)	Basic	Neutral
Potassium Carbonate	0-0-30	Basic	Alkalizing
Potassium Thiosulfate, KTS, or K-MEND	0-0-25-17	Basic	Mildly acidifying[2]
Magnesium Sulfate	0-0-0-14(S)-10(Mg)	Basic	Neutral
	2-7-17-11(S)	Blended	Acidifying
	3-10-10-2(S)	Blended	Acidifying
	3-11-17 or 18	Blended	Acidifying
	5-0-8	Blended	Acidifying
	6-2-10	Blended	Acidifying
	6-2-13-4(S)	Blended	Acidifying
	8-4-8	Blended	Acidifying
	8-8-8-2(S)	Blended	Acidifying
	10-0-10	Blended	Acidifying
	12-0-9	Blended	Acidifying
	15-4-5-3(S)	Blended	Acidifying

[1] Sources: Burt (1998), Christensen (1995), Mid Valley Agricultural Services (2002), Western Fertilizer Handbook (1998).

[2] Neutral until acted upon (oxidized) by sulfur oxidizing bacteria (*Thiobacillus* sp.)

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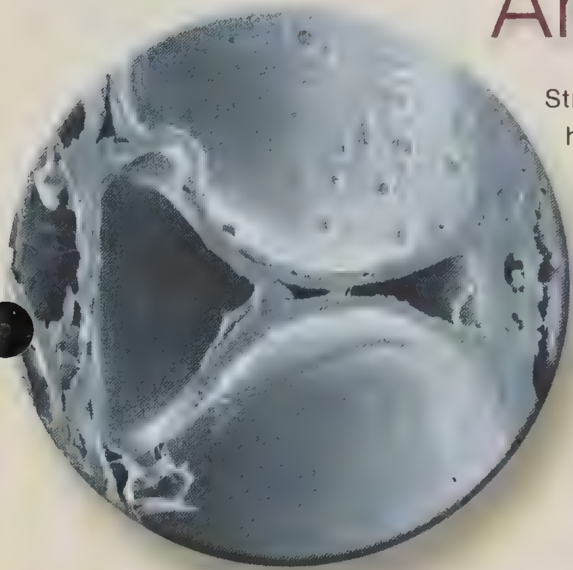
(the fragile sessile oak, Quercus petraea Liebl.)

American Oak



Structural differences in American oak's hemicellulose and lignin result in more intense vanilla, wood sugars and toastiness. Because stave timber is purchased from private landowners, log costs are lower, plus its density, high tyloses and straight grain means higher yields, fewer trees, a smart use of natural resources and a lower cost barrel with popular traits.

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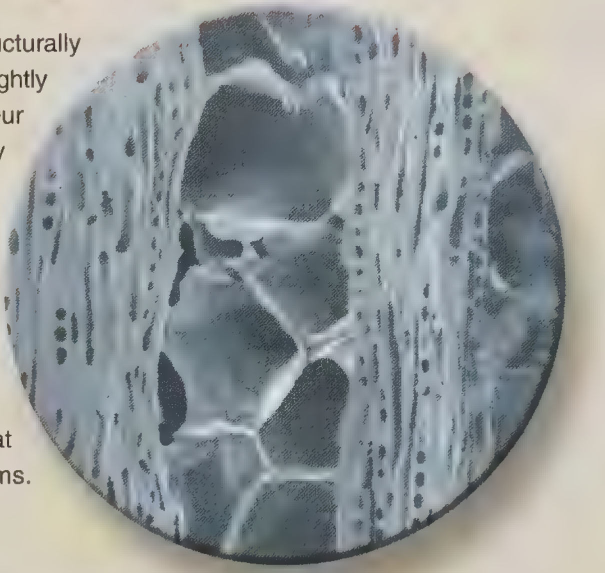

(the slow growth, Quercus petraea Liebl.)

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Nutrient uptake can be artificially restricted through irrigation practices that reduce soil moisture and impose water stress on grapevines, such as regulated deficit irrigation (RDI). Although movement in the soil and uptake of all nutrients are affected by soil moisture status, some, such as potassium, are affected more than others.[34,55] The impact of soil moisture on nutrient uptake is an important reason to impose moderate rather than severe water stress during fruit ripening.

For unknown reasons, about 30 days after harvest, potassium uptake abruptly diminishes.[9] In contrast, nitrogen and phosphorus uptake continues until the onset of leaf fall.[8,9] During this time about 30% of the seasonal nitrogen requirement is taken up, and most of this (65% to 75%) is stored in the woody tissues of the vine.[11] Uptake and storage of nitrogen and phosphorus are enhanced when active leaves are maintained as long as possible.

The ability of vineyard management to apply fertilizers several times during the growing season to the active part of the root zone is critical to a balanced nutrition program. Development of drip irrigation and fertigation technologies has made this possible.[D]

[[D]Simultaneous application of multiple nutrients is possible with foliar fertilization technology. However, the low capacity of foliar tissues to absorb nutrients greatly limits fertilizer uptake (and the longevity of the corresponding response of the vine). Even repeated foliar applications are inadequate, if not cost-prohibitive, for some macronutrients.]

Another technological requirement involves the fertilizers themselves. They must be highly soluble so that they remain dissolved in irrigation water and, after reaching the root zone, remain readily available to vines. An array of liquid fertilizers has been developed to meet these needs (Table IV).

Other fertilizer considerations

Fertilizers have chemical characteristics other than their nutrient content, some of which can effect changes in soil chemistry. Consideration of these characteristics in a balanced fertigation program is essential to the maintenance of a healthy root zone, particularly with drip irrigation because of the small, intense root zone it creates.

The equivalent acidity or basicity of a fertilizer refers to its potential to decrease or increase soil pH, respectively.[5,48] The influence of fertilizer on soil pH may be either advantageous or disadvantageous.

For acid or alkaline soils, properly selected fertilizers may be used to advantage by promoting soil neutralization. However, on these same soils, improperly selected fertilizers may intensify existing pH problems.[21,34] On near-neutral soils, fertilizers should be selected to maintain neutral pH. Fertilizer-induced changes are more of a concern for sandy soil than clay soil due to differences in their lower buffering capacity (such as the capacity to resist changes in pH).

In general, nitrogen and phosphorus fertilizers have the greatest effect on soil pH.[48] Of these two nutrients, nitrogen fer-

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tilizers are commonly of greatest concern because they are applied to a larger portion of the root zone, and acidity from them persists longer in the soil. Among nitrogen fertilizers, those containing nitrogen in the form of ammonium and urea are acidifying, while those in the nitrate form are nearly pH-neutral.

The salt index indicates the potential of a fertilizer to increase the salinity of a soil.[32,48] In general, higher analysis fertilizers (those with a high nutrient content) will have less effect on soil salinity than a lower analysis fertilizer does when used to apply the same amount of nutrient per acre. Also, the salt index increases with fertilizer solubility in water.

Fertilization of salt-affected soils are a great concern, because they are frequently associated with poor internal drainage. However, salt loading in any soil may decrease the rate of water infiltration, damage young roots, and inhibit beneficial soil microorganisms. With careful fertilizer selection and application scheduling, soil salinization from fertigation will be negligible except possibly in a very small volume of soil at the edge of the wetted zone or where wetted zones coalesce.[18]

Additional specific information about fertilizers suitable for injection into drip irrigation systems, along with their most effective use, are available from several sources.[3,4,28,41,48]

Designing a balanced fertilization program: Fertilizer materials

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Table V. Basic balanced fertigation program.

Application Period	Fertilizer Formulation	Fertilizer/ Acre	Ammonium	Nitrate	N	P	K	Ca	Mg	S
		gal	lb/ac	lb/ac	lb/ac	lb/ac	lb/ac	lb/ac	lb/ac	lb/ac
Prebloom	3-10-10-3(S)	7	2.1	0.0	2.1	3.1	5.8	0.0	0.0	2.1
	CN-9	4	0.3	4.1	4.4	0.0	0.0	5.4	0.0	0.0
	Subtotal	11	2.4	4.1	6.5	3.1	5.8	5.4	0.0	2.1
Post bloom	3-10-10-3(S)	10	3.0	0.0	3.0	4.4	8.3	0.0	0.0	3.0
	CN-9	2	0.1	2.0	2.2	0.0	0.0	2.7	0.0	0.0
	Subtotal	12	3.1	2.0	5.2	4.4	8.3	2.7	0.0	3.0
Post harvest	3-10-10-3(S)	13	3.9	0.0	3.9	5.7	10.8	0.0	0.0	3.9
	CN-9	3.5	0.2	3.6	3.8	0.0	0.0	4.7	0.0	0.0
	Subtotal	16.5	4.1	3.6	7.7	5.7	10.8	4.7	0.0	3.9
SEASONAL TOTAL		40	9.7	9.7	19.4	13.1	24.9	12.7	0.0	9.0

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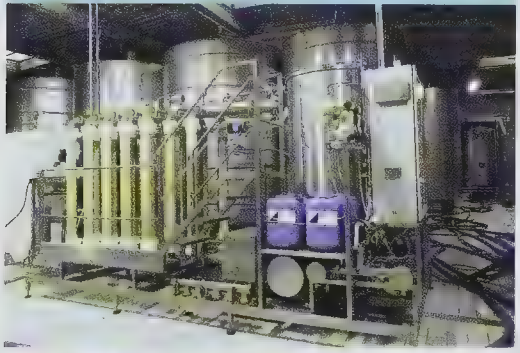

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basic balanced fertilization program. This program assumes a deep, well-drained, fertile soil of medium texture (fine sandy loam to silt loam), neutral pH, low salinity, and no nutrient excesses. The character of this soil changes little with depth, with the exception that the surface soil contains more mineral nutrients than the subsoil. Also, there are no unusual conditions that would inhibit nutrient uptake by grapevines.

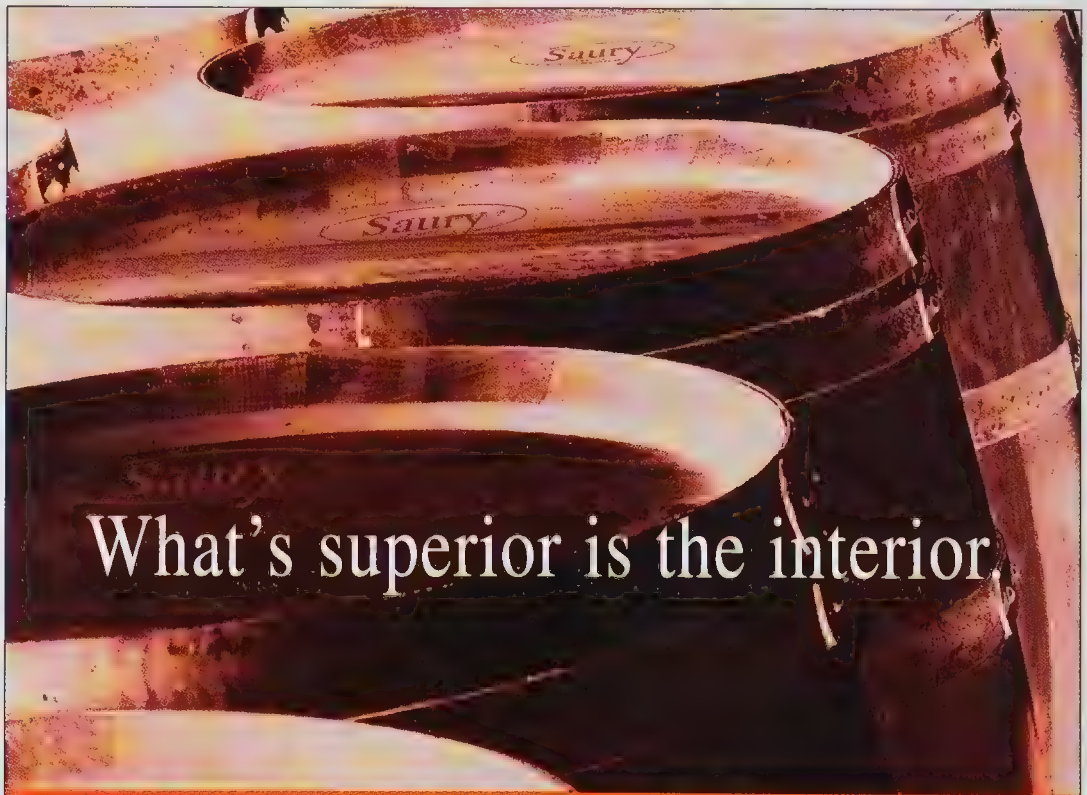
Examples of these conditions can be found on Yolo series soils in the Napa Valley, Tokay series soils in the Lodi area, Sierra series soils in the Shenandoah Valley, and Arbuckle and Still series soils near Paso Robles.[42,43,44,45]

The program also assumes the following: 1) mature, bilateral, cordon-trained vines that had well-nourished, well-balanced growth during the previous season and went dormant with sufficient stored mineral nutrients in permanent parts of the vines; 2) soils that have been managed for mineral nutrient conservation, with minimum surface runoff and soil erosion due to the presence of a grass cover crop, and efficient irrigations; 3) Irrigation water that contains low levels of nutrients and salts.

The target yield for the current season is about six tons per acre of optimum quality fruit. Regulated deficit irrigation (RDI), in which moderate water stress is maintained during fruit ripening, will be practiced for enhanced fruit and wine quality. The basic program is structured around key grapevine phenological events.

Balanced fertilization programs are usually initiated with some nutrients applied at comparatively high rates to compensate for initial imbalances in soil nutrient supply. Still, it is important that most, if not all, nutrients are included in the program from the beginning of the season.

Without the inclusion of most nutrients, the soil under the drip emitter would soon become loaded with the recently applied fertilizer nutrients, and a new nutrient imbalance would develop.[E] Nutrient interactions in the soil, in which



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some nutrients either depress or stimulate uptake of other nutrients, intensify the effects of nutrient loading.[1,48]

[[E] For example, on a sandy loam soil, in less than two years, I made a significant shift in the soil nutrient equilibrium with frequent fertigated applications of 8-8-8 fertilizer. This was not a balanced program and soil levels of calcium and magnesium, which were formerly high, became very low relative to potassium. The soil pH had also decreased significantly.]

Determination of fertilization rates begins with consideration of nitrogen, because it is the nutrient most often in limited supply in soil, most often lost to leaching and volatilization, and most often responsible for detrimental under- or over-fertilization effects in vineyards.

In the basic program, the seasonal total target nitrogen is the product of the targeted yield and the nitrogen content of fruit, which is about 18 pounds per acre (6 tons/acre x 3 lbs. N/ton). Six tons of fruit will also contain about 3.5 lbs. phosphorus, 30 lbs. potassium, 6 lbs. of calcium, and 0.6 lb. magnesium.

Although fertigation is normally the most effective method of fertilizer application, actual fertilizer use efficiency can be quite low.[56] For this reason, fertilizer application rates often need to exceed replacement of nutrients in the harvested fruit to fully satisfy plant nutrient demand.

Selection of fertilizer formulations is used to achieve the desired ratio of nitrogen forms. Fertilizer formulation selection is also used to determine application rates and ratios of nutrients other than nitrogen.

Prior to bloom, rapid development of full canopy is our primary vineyard management goal. Achieving this goal assures adequate leaf area for fruit ripening before the developing fruit becomes the main sink for vine resources.

Prebloom nutrient uptake from the soil is often limited by cool weather, cool soils, and limited transpiration. Much of the prebloom demand (20% to 30% of N demand) for mineral nutrients is met by reserves remobilized from the permanent vine structure.[7,8,9,10,11,12,15]

Still, in many vineyards, the demand for nitrogen exceeds the stored supply. Supplemental nitrogen from an external source is needed. A basic fertilization program includes nitrogen to meet this need, plus small amounts of other nutrients (particularly phosphorus and potassium) to balance the applied nitrogen and to build soil levels in anticipation of a surge in their demand following bloom (Table V).[F]

[[F] In this example soil fertility program, fertilizers will be applied through the drip irrigation system. Under some conditions it may be more desirable to apply nitrogen as dry fertilizer to the vine row. Under other conditions, the requirement may be met with the nitrogen contained in applied soil amendments or incorporated legume cover crops.]

The prebloom portion of the balanced fertilization program will use two fertilizers (Table V). Most of the nitrogen is supplied as nitrate (calcium nitrate, CN-9), which is pH-neutral, while a much smaller amount is supplied as ammo-

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nium in the N-P-K formulation 3-10-10. The small amount of applied ammonium may increase vine response to nitrogen fertilizer.[38,52] The N-P-K fertilizer also contains a micronutrient package.

Calcium nitrate and N-P-K fertilizers are incompatible because the calcium in the former will react with the phosphorus in the latter to form solid calcium phosphates.[3,17] Therefore, two fertilizer storage tanks are required — one for each fertilizer. Also, it is best to inject the fertilizers independently during separate irrigation events, with a complete flushing of the irrigation system in between.

Following bloom, the emphasis in fertilizer nutrients shifts slightly from nitrogen to potassium as the nutrient demand in the fruit greatly increases. The relative amounts of calcium nitrate and N-P-K fertilizers scheduled for application between bloom and veraison reflect this shift in nutrient demand. Potassium applied during this time may increase cane wood density and winter hardiness.

Generally, no fertilizer applications are required between veraison and harvest. However, if ripening appears delayed or variable, fertilizers may be beneficial. Potassium is frequently beneficial during this time, as the ripening fruit has continuing demand that is met mainly by a supply remobilized from vegetative organs.[53]

Post-harvest fertilizer amounts are similar to post-bloom. Irrigate to maintain active leaves as long as possible during autumn to enhance nutrient uptake and storage.

Designing a balanced fertilization program: Application timings

Some researchers have recommended application of fertilizers in very frequent, low doses to maintain a continuous, moderate nutrient supply in the soil solution and to maximize fertilization efficiency.[2,37] This frequent, light dose strategy works very well for vines on sandy soils managed for maximum production, but is not consistent with production and quality objectives in many other instances.

For most vineyards with low vine biomass per acre or soils with large moisture holding capacities, irrigations are delayed in the spring and applied infrequently during the growing season. Under these conditions, fertigations will also be infrequent.

In the sample program, the two prebloom fertilizers will be applied in separate irrigation events, both of which will last only long enough to fully charge the irrigation system, inject the fertilizer, and flush the system. CN-9 will be applied in the first irrigation, 3-10-10 in the second.

Between bloom and veraison, apply fertilizers in three applications in the following sequence: 3-10-10, CN-9, 3-10-10. Apply post-harvest fertilizers in the reverse order of pre-bloom (3-10-10 followed by CN-9), to gain maximum benefit from fertilizer potassium. Post-harvest irrigations, particularly the first, will be longer in duration than pre-bloom irrigations to fully wet the root zone.

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Modifications to basic program

The basic fertilizer program described above is appropriate for average vineyard conditions, but can be adapted to other conditions if appropriately modified.

Increase basic program application rates for vineyards on soils of lower fertility.[7] However, increasing fertigation rates alone may not be sufficient for soils of very low fertility, particularly for soils low in phosphorus or potassium.[17,48] Some soils have a large capacity to absorb these nutrients, and large quantities of fertilizer are required to saturate the soil's adsorption capacity.

Over time, with continued phosphorus and potassium fertigation, the volume of soil beneath the drip emitter will become saturated, but more rapid nutrient availability may be possible with shanked applications of dry fertilizer adjacent to the vine row. Correction of deficiency may require dry fertilizer application rates as high as one pound phosphorus or three pounds potassium per vine.[6,17]

Cover crops compete with grapevines for nutrients, requiring increases in vineyard fertilizer application rates.[22,23,47] Also, when environmental conditions early in the growing season limit foliage growth, the rate of growth some times can be stimulated with applications of nitrate-nitrogen (5 to 10 gal. CN-9 per acre).

Although fertilization of low fertility soils must be aggressive, care must be exercised not to over-fertilize. Seasonal nitrogen application, even for very low-vigor vineyards, should rarely, if ever, exceed 50 pounds per acre to avoid excessive foliage, decreased fruitfulness, delayed fruit maturation, and diminished fruit quality.[13,15,33,46]

To avoid toxicity, the concentration of nitrogen in the drip system should never exceed 1000 ppm.[28] Excessive fertilizer potassium applied late in the ripening period may increase fruit pH to undesirable levels.[20,31] For all nutrients, frequent, small-dose fertilizer applications are less likely to create undesirable side effects than infrequent, large-dose applications.

Low soil magnesium (Mg less than 25 ppm or Mg less than 10% of the exchangable cations) requires special application considerations. Fertilizer magnesium, like fertilizer calcium, reacts with N-P-K fertilizers to form solid magnesium phosphates and consequently, must be kept separate from them in storage and during injection.

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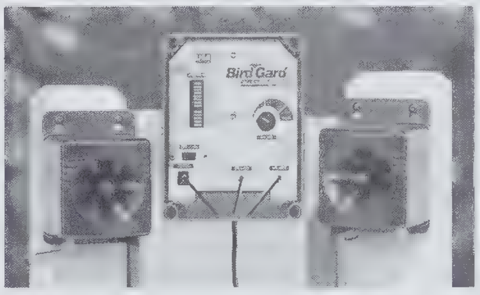

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Some soils may have very high fertility due to fertilizer residues from previous use, such as intensive farming of vegetable crops. Some irrigation waters may be high in nitrogen and may serve as the primary source of that nutrient.

Vineyards with small vines and low vine densities will have a low nutrient requirement. In these and other instances where there is an ample available supply of one or more nutrients, the corresponding nutrients in the basic fertilizer program should be lowered or, occasionally, eliminated.

The basic program may be altered to advantage for soils of high pH (*i.e.* alkaline soils). As mentioned earlier in this article, some nitrogen sources are acidifying. Examples include UN-32 and most N-P-K blends. Over time, use of acidifying fertilizers will decrease soil pH and neutralize soil alkalinity.

Saline soils require careful fertility management. Use only fertilizers with low salt index values (such as high analysis fertilizers), and apply them in frequent, small doses to avoid contributing to the existing salinity.

A continuous, balanced supply of micronutrients is required during the growing season. Regular applications assure their availability, and fertigation is a very effective technology for their application in non-alkaline soils. In soils with no significant micronutrient deficiencies, apply micronutrients roughly in ratios found in grapevine tissues.[1,6,40] The ratio I currently use is 1: 1: 1: 4: 0.25, representing boron: zinc: manganese: iron: copper.

Low micronutrient levels in soil where there is a history of deficiency should be balanced by fertilization programs emphasizing higher application rates. To avoid toxicity, rarely, if ever, apply more than one pound of boron per acre per year.[36]

Soil fertility program quality assurance

As with any vineyard management program, balanced soil fertility management requires monitoring and measuring to assure desirable performance. The basic quality assurance measure is vine appearance.

Internodes should be of normal length and diameter, and leaves should be normal in size and color. If they do not look normal, and assuming other management inputs have been applied correctly and vines are not suffering from other stresses, the program needs to be adjusted by applying either more or less fertilizer.

During bloom several nutrients reach peak concentrations in leaf tissues, making it a convenient time for analyzing nutrient status. Viticultural researchers have developed criteria for evaluating bloom leaf tissue status for deficiencies of most nutrients and excesses for a few nutrients.[6,40] These criteria, in conjunction with observations of vine and environmental conditions, may be used for fertility management program adjustments.

Soil samples collected from the vine row are also of value in soil fertility program quality assurance. A minimum panel of analyses for soil fertility quality assurance includes pH, salinity, concentrations of available nutrients, and percent base saturation.

While samples collected and analyzed at the beginning of the season indicate initial soil conditions and initial nutrient imbalances, samples collected late in the growing season represent the cumulative effects of the program. Late season soil analysis is particularly important for monitoring fertigation effects on acid, alkaline, and saline soils.

Uncorrected nutrient imbalances make vines more prone to pests, diseases, and winterkill.[14,39,51,55] They also result in fruit of low or high pH, high volatile acidity, low ratio of tartrate to malate, poor color, low phenolics, stuck fermentations, production of undesirable compounds (such as hydrogen sulfide and ethyl carbamate) and off flavors.[6,16,19,20,24,25,31,40,46,49] Certainly, avoidance of these is an important measure of soil fertility management program quality. Consistent, balanced growth of foliage and fruit is the ultimate measure of program success. ■

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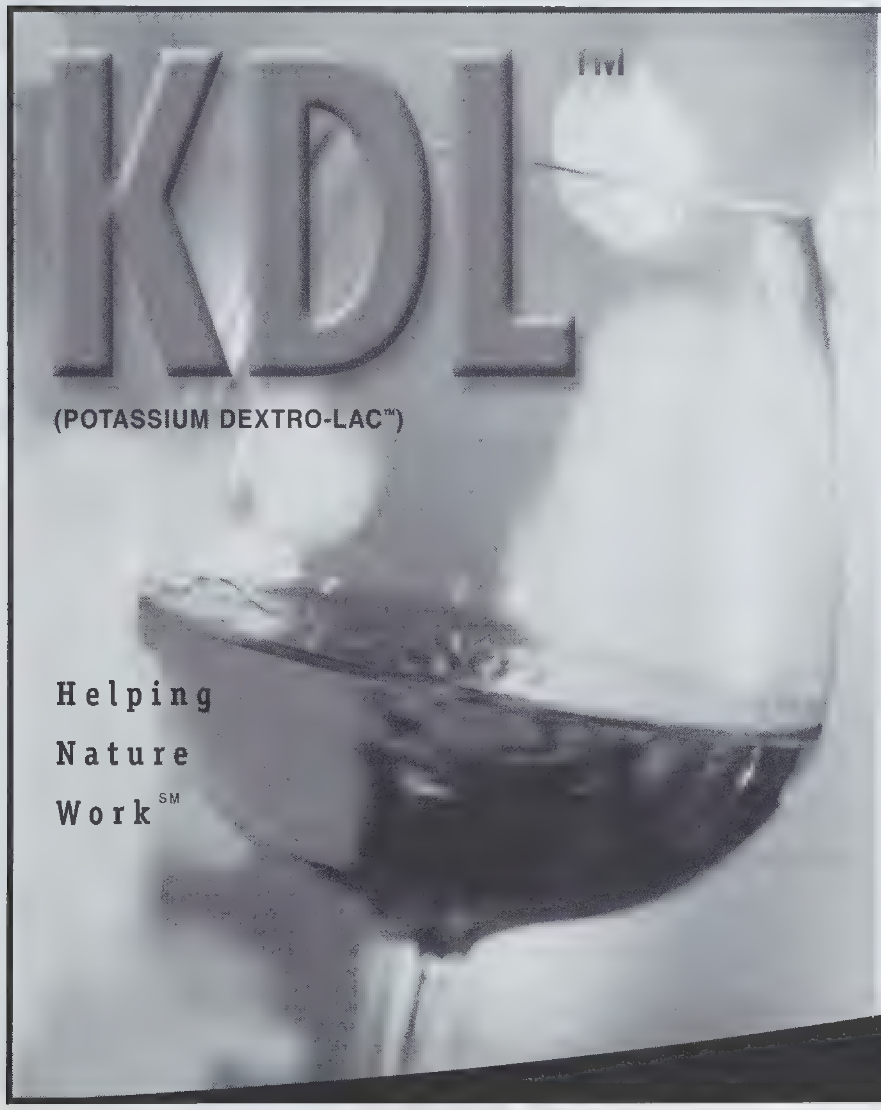

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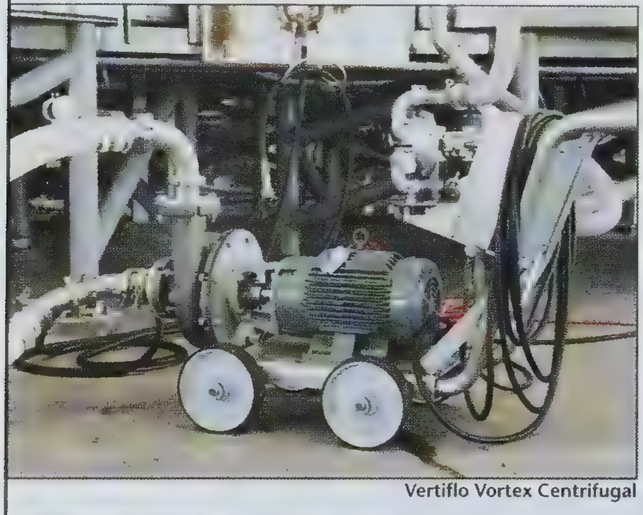

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DIFFUSE POWDERY MILDEW

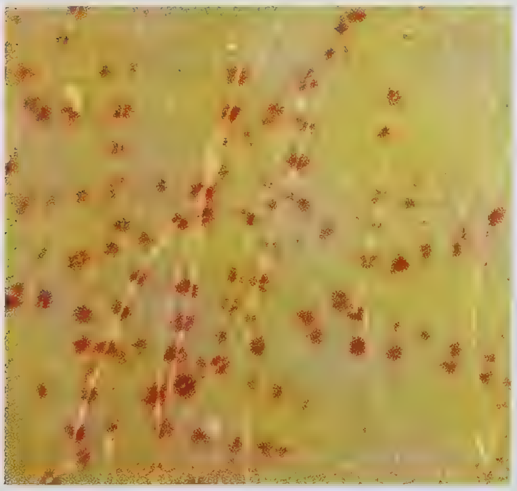
Wine quality's hidden foe

BY Dave Falchek

Powdery mildew is turning out to be an even more troublesome — and under certain conditions, a much more insidious — disease than originally thought.

When left unchecked, grape powdery mildew's effect on yields is well-known. However, an interdisciplinary team of Cornell researchers has shown that a previously unnoticed form of powdery mildew infection on berries can predispose fruit to other fungal diseases, microbial contamination, and perhaps even to insect damage.

While in some cases the mechanisms have yet to be established, the team has found strong relationships among these conditions, reports senior research associate Dr. David Gadoury of the Cornell Department of Plant Pathology. Gadoury spoke at the 53rd Annual Finger Lakes Grape Growers Conference in Seneca Falls, NY, (February, 2002).



This magnified (35X, oblique illumination) view of a diffuse powdery mildew colony on a Chardonnay berry shows the network of dead epidermal cells. Such berries are at greater risk for bunch rots and colonization by spoilage microorganisms.

"We've discovered a form of diffuse powdery mildew infection that is both virtually invisible on berries under field conditions and has unforeseen effects on juice and wine quality," Gadoury says.

Diffuse powdery mildew — sparse, non-sporulating, and inconspicuous colonies from early season infections — predisposed clusters not only to bunch rot but also to colonization of the berry by numerous spoilage microorganisms. Diffuse powdery mildew also made the clusters more attractive to sap beetles, ants, and wasps. The clusters showed 30 times greater levels of infestation than mildew-free grapes.

In the cellar, wine from grapes with diffuse powdery mildew showed greater levels of spoilage microorganisms and non-*Sacchromyces* yeasts. Tasting panels comparing wine made from grapes showing diffuse powdery mildew often found a marked decrease in wine quality.

Gadoury found that berries of many *Vitis vinifera* cultivars are highly susceptible to infection by grape powdery mildew (GPM) at a narrow point of development, before berries develop their natural ontogenic (age-related) resistance three to four weeks post-bloom.

If the berries are infected just before they become immune, GPM can infect the partially resistant berries, and then grow for several days. As the berries' natural resistance strengthens, the GPM colony dies out, leaving what appears to the naked eye to be healthy fruit. But by this time the colony has killed portions of berry tissue, leaving a "web" of necrotic cells on the berry skin.

A yellowjacket feeds on a Chardonnay cluster infected with diffuse powdery mildew. These insects are attracted to volatiles given off at elevated concentrations by fruit bearing diffuse powdery mildew colonies. (Images provided by Dr. David Gadoury.)

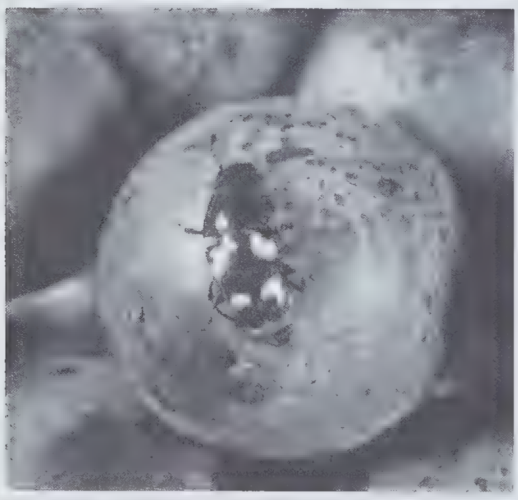
That process might compromise the natural barrier provided by the berry skin, making it more susceptible to rots, spoilage microbes, and perhaps making it more attractive to insects that feed on fruit, Gadoury believes.

To examine the relationship between GPM and bunch rot, plots of Pinot Noir on the east side of Seneca Lake were subjected to the same rigorous spray program to keep all plots disease-free prior to inoculation. At three weeks post-bloom, in between sprays and just before the berries became immune to powdery mildew, clusters in some plots were inoculated with conidia of powdery mildew.

"There was a clear association between the presence of powdery mildew and occurrence of bunch rot," Gadoury says. "Grapes that appear equally disease-free in the field may differ greatly in the amount of diffuse powdery mildew they support, and in their risk of developing bunch rot."

Researchers scanned samples from both treatments in the lab. Since the diffuse infection is invisible to the naked eye, researchers examined grape clusters at 50X power magnification under low-angle light to see the microscopic "netting" left by dead GPM colonies.

Over three years of trials, bunch rot was always found to be five to 10 times more severe when berries in the cluster had diffuse powdery mildew. In fact, the study showed that even when only about 3% of the berry surface bears diffuse mildew colonies, the clusters may suddenly rot at harvest, suggesting



A sap beetle feeds on Pinot Noir berries with diffuse powdery mildew. These insects were found to be 30 times more numerous on fruit infected with diffuse powdery mildew than on mildew-free fruit.

to Gadoury that "it doesn't take much." On healthy, mildew-free fruit, only trace levels of bunch rot occurred.The findings have prompted the research group at Cornell to speculate that at least part of the reported efficacy of JMS Stylet Oil against bunch rot is due to its excellent control of mildew on berries. Gadoury guesses that Stylet Oil may be controlling diffuse powdery mildew, and in doing so, indirectly controlling *Botrytis*.

As for the insect infestation problem, researchers found that diffuse powdery mildew berries were giving off elevated levels of three volatile compounds that attract insect pests. Using solid-phase extraction and gas chromatography, they compared the concentrations of ethanol, ethyl acetate, and acetic acid from mildew-free fruit and fruit with diffuse infection. The results were dramatic. Infected fruit gave off 6.5 times the amount of volatile ethanol and 258 times the ethyl acetate.

Most dramatic was the amount of acetic acid given off by infected fruit — over 1,000 times the amount of healthy fruit. "Off the scales," Gadoury notes. "It's not yet clear if insects are actively involved in accelerating the breakdown of clusters with diffuse powdery mildew, if they are attracted to increased level of volatiles, or both."

Powdery mildew's problems continue in the cellar. Comparing the microflora of infected fruit and disease-free fruit, researchers found a huge increase in microorganisms in fruit with diffuse powdery mildew. Researchers looked for acetic and lactic acid bacteria, yeast genera such as *Kloeckera, Candida, Matchnikowia, Pichia,* and *Saccharomyces.*

Evaluating total colonies per 100 micro liters of must, mildew-free fruit showed only trace amounts of microbes. Must from diffuse powdery mildew fruit had more than 1,250,000 colonies.

"Against such a large population, the addition of SO_2 and yeast starter culture is only partially successful," says Dr. Thomas Henick-Kling, the enologist of the group. Work at Cornell continues in identifying fermentation techniques that control or mitigate the effects of potentially harmful microorganisms.

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Although many of these microbes die during fermentation, such high microbial activity can be expected to have an effect on the sensory quality of the resulting wine, adds Henick-Kling.

Yeasts such as *Brettanomyces, Dekkera, Kloeckera,* and *Hanseniaspora* have high spoilage potential. "Brett" is notorious for sensory defects with descriptors ranging from "Band-aid" and "wet dog" to "horse manure."

Tasting trials in 1998 were done from Pinot Noir with 0% to 5% and 20% to 30% diffuse powdery mildew. The 0% to 5% powdery mildew Pinot Noir was described as "pale red, strawberry aroma with no off-flavors." The 20% to 30% was described as "dusty, plasticy, moldy, flat in body."

In the 1999 vintage, three of four tasters strongly preferred Pinot Noir and Chardonnay made from low- to no-powdery mildew grapes. Other wines' aromas were described as "earthy, plastic, papery," and "bruised apple." Yet, powdery mildew did not have an effect on the flavor of these wines.

In 2000 and 2001, Pinot Noir and Chardonnay wine quality did not change due to powdery mildew. Acetic and lactic acid, major determinants of spoilage, were the same in all groups.

Still, Gadoury reports the results are consistent in that wine defects are greater and more frequent with GPM-infected berries.

"Inconsistent or rare defects should still be of concern. As a wine producer, you don't get many chances with a consumer. Scores of bottles of well-made wine will be quickly forgotten when one bottle smells like manure."

Bad to worse

At its uncontrolled worst, powdery mildew can result in reduced vine growth and yield, poor fruit quality, and loss of winter hardiness.

Powdery mildew can infect all green tissues of the vine, which develop small, white and gray patches on leaves. These patches get bigger and cover the entire leaf. Infected leaves become distorted and stunted as they grow. If blossom clusters are affected, the flowers may wither and drop without setting fruit. Late in the season, infected areas may show black specks upon the surface of mildew colonies. These are "cleistotheca" and are reproductive structures which allow the pathogen to survive winter. In colder climates, they are the only means of overwintering, while in warmer regions they are, in addition to flag shoots, an important source of inoculum during spring, suggesting that the fungus is reproducing.

Unlike other fungal diseases such as black rot and downy mildew, the powdery mildew fungus does not require free water on the plant tissue surface in order to infect. Varieties of *Vitis vinifera* and interspecific hybrids generally are more susceptible than varieties derived from the North American grape species *Vitis labruscana.*

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KOMEX
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GPM was a minor disease in New York when viticulture was based on native, *Vitis labruscana* grapes such as Concord and Catawba. Native grapes, having evolved with GPM, developed a strong resistance to the local pathogen.

In the 1840s, GPM spread to Europe, nearly destroying the European industry before winemakers there learned to control it using sulfur. Today, powdery mildew occurs in nearly all major viticultural regions.

Gadoury and the Cornell team have found that powdery mildew manifests itself in an inconspicuous way, invisible to the grower, even as it may be causing further disease, pest, and microbial problems.

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Disease and pest control begins before the first vine is planted. Select an open planting site with direct sunlight. Plant rows in the direction of the prevailing wind to promote good air circulation and faster drying of foliage and fruit. Prune and train vines to reduce shading and increase air circulation.

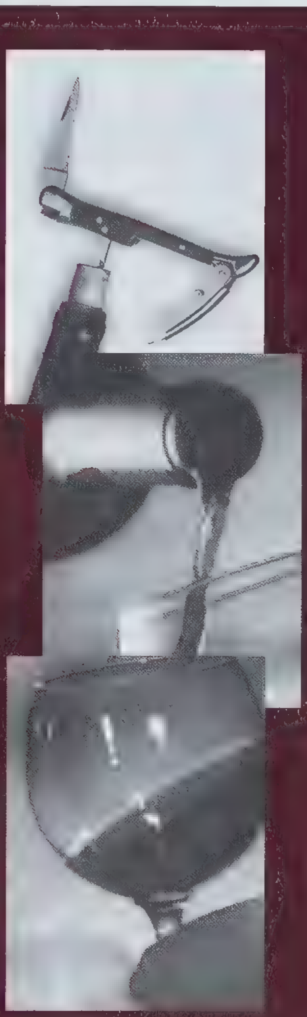
While those measures help, it's no substitute for a spray program, according to Gadoury. "We need to remember we are in the center of diversity for all major pathogen groups," he reminds northeastern growers.

With several effective fungicides available to combat GPM, Gadoury notes that growers have more and better choices than in the early 1990s. However, fungicide effects often wane over time, losing their effectiveness due to pathogen resistance. They can also be banned by regulators.

Growers should protect fruit intensively, and extend that protection fully until four weeks post-bloom, at which time grapes will have developed ontogenic resistance to GPM. This should protect fruit from a diffuse powdery mildew infection. Additional sprays may be necessary to protect foliage, especially in cooler climates where premature defoliation leads to reduced winter hardiness. However, it is the sprays that are applied during the brief (but critical) period of fruit susceptibility that carry all of the weight with respect to producing mildew-free fruit.

"You are protecting your fruit from something you cannot see," says Gadoury. "There may not be a visible difference in clusters when you spray, but there will be a difference at harvest." ■

The research was largely funded by the New York Wine & Grape Foundation. Other researchers on the issue include Professors Robert C. Seem and Wayne F. Wilcox of Cornell Department of Plant Pathology, and Thomas Henick-Kling of the Cornell Department of Food Science.



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REFINING THE *art* OF Pinot Noir

RUSSIAN RIVER VALLEY WINEGROWERS

BY Eleanor & Ray Heald
Contributing editors

Clones are the buzz word in California Pinot Noir production. As they evaluate plant material and new clonal selections, winemakers and viticulturists in Sonoma County's Russian River Valley American Viticultural Area (AVA) point to additional factors influencing Pinot Noir quality.

Climate, soil, fog intrusion, elevation, and rootstocks join clones as influences priming the Russian River Valley for high-quality Pinot Noir production. When all factors are evaluated, however, producers say it's essential to baby this baby!

"Given the limited volume of top-quality Pinot Noir produced in the Russian River Valley (RRV) to date," Lynmar's Daniel Moore says, "*terroir* does not immediately apply. To assess *terroir* in the French tradition requires tasting a multiplicity of Pinot Noir bottlings from the same producers over a span of many years."

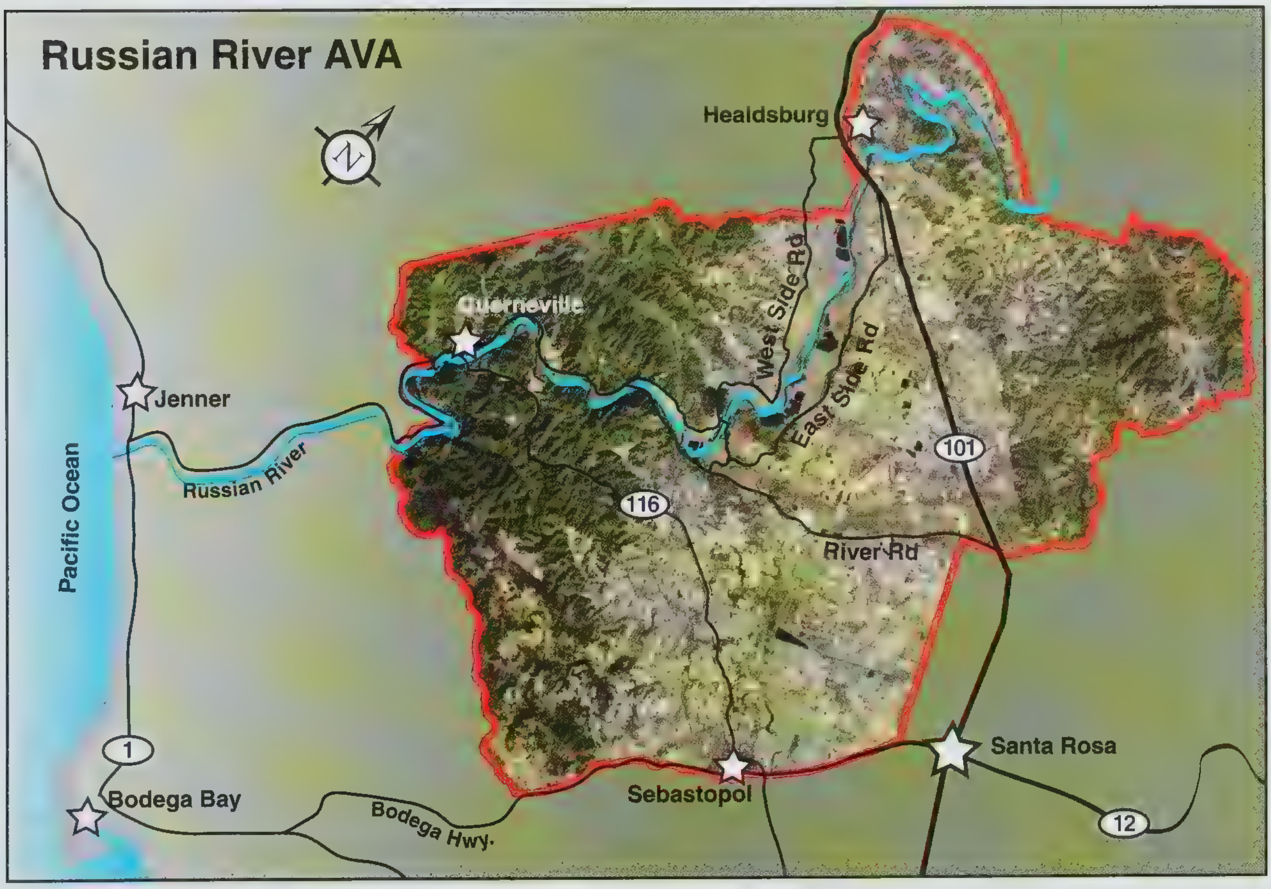
Considering RRV's short high-quality Pinot Noir history, Moore contends that it's more important to talk about climate and implementation, and planting new clones in experimental blocks. He also cites the importance of evaluating these factors in specific soils, within a given climate. Compared to the original planting of Swan selection he has worked with at Lynmar in the past, he finds significant differences in wine quality based on newer Dijon clones.

Oded Shakked of J. Wine Company notes that the RRV climate is difficult to define. In reality it's a multiplicity of microclimates. He works with six different RRV vineyards, each with a unique microclimate.

Hartford Family Winery's viticulturist Walt Chavoor also notes that there are too many variations to cite RRV as a uniform climate. "Once lower-yielding clones are chosen," he says, "the difference between clonal selections becomes less pronounced. With lower yields, the principal influences become soil and climate. Clone selection is not insignificant, but soils make an incredible difference."

Rodney Strong's viticulturist Doug McIlroy cites the importance of matching rootstocks to soil profile. For best wine quality, even on less fertile soil, lower-yielding clones of Pinot Noir perform best and yield top wine quality on less vigorous rootstocks such as 3309.

McIlroy adds fog to the list of RRV influences. Fog relates to elevation and the site's location with respect to various mountain ranges. He



Images provided by Russian River Winegrowers.

cites Westside Road, Eastside Road, and Chalk Hill as areas of limited fog intrusion. "Wine style from vineyards in these locations is different from the Sebastopol area," he notes. "There, the southern part, in particular, is influenced by the marine layer and elevation."

From a topographical map, it's easy to observe that the coast range, along the border of RRV and the Sonoma Coast AVA, is higher along Westside and Eastside Roads, and therefore influences the Chalk Hill area. Some mornings there may not be fog, but on others, it can form and clear the top of hills.

"Between Forestville and Sebastopol, there's another kickup of fog intrusion," McIlroy continues, "but it's not as significant as in the southern end, in Green Valley, where it is the greatest. Since cooler areas tend to naturally set a lower crop, fog influences yield, ripening patterns, wine color, and ultimately wine style. Climate is equally as important as soil when discussing Pinot Noir."

PARTICIPATING PRODUCERS:

Mike Sullivan, Winemaker
Walt Chavoor, Vineyard Manager
Hartford Family Winery,
Forestville, CA

David Munksgard, Winemaker
Iron Horse Vineyards,
Sebastopol, CA

Oded Shakked, Winemaker
J. Wine Company,
Healdsburg, CA

Eugenia Keegan,
Owner/Winemaker
Keegan Cellars, Napa, CA

Daniel Moore, Winemaker
Lynmar at Quail Hill Vineyard,
Sebastopol, CA

Bill Dyer, Technical Director
Marimar Torres Estate,
Sebastopol, CA

Rick Sayre, Winemaker
Douglas McIlroy, Director of
Grower & Vineyard Operations
Rodney Strong Vineyards,
Windsor, CA

Bob Cabral, Winemaker
Williams Selyem,
Healdsburg, CA

Traditional clonal selections

Twenty years ago, the Martini Clone was the principal Pinot Noir selection planted in RRV, Rodney Strong Vineyards winemaker Rick Sayre notes. The winery's River East Vineyard has 35-year-old-plus vines still producing. The principal fruit characteristics are succulent strawberry and red cherry. Color is a problem, but the wine is always soft and supple. So soft, that Sayre adds back stems to the fermentor to increase tannin level. This fraction does, however, make a voluptuous part of a blend, adding weight and creaminess.

Winemaker Mike Sullivan also uses this clone for the Hartford Court Arrendell Vineyard Pinot Noir. Site, he says, shifts the expression of the Martini Clone dramatically. It can develop more masculine, black fruit characteristics, such as boysenberry and blackberry. Structure is impacted by both soil and crop load.

Yet Chavoor says it's difficult for him to separate the influence of clone from site. He believes that growers of Pinot Noir in RRV do not have sufficient experience to be able to make these comparisons yet.

In reference to the old Swan selection plantings at Lynmar, Moore notices much denser, richer flavors at 22° to 22.5° Brix with Dijon clones and even the Pommard clone. With the Swan selection, such qualities do not become apparent until almost 24° Brix. Physiological maturity at lower Brix and holding acid levels are apparent advantages of Dijon clones.

Among the vineyards sourced by Keegan Cellars, Eugenia Keegan has a 4.5-acre block on Eastside Road that has six different selections planted: Pommard, Swan, 113, 115, 667, and 777. The goal is to observe these selections for future planting. They've all performed well, and she would reject none of them for the future.

Keegan explains that with Swan, two selections have been planted in RRV. It's difficult to pinpoint exactly which is which. "What I have planted," she says, "has deep, dark color with dark fruit characters. It can be vegetative in the positive sense. Like Pommard, I tend to recommend Swan as a balancing act in a new vineyard, along with Dijon clones.

Keegan has Pommard (UCD Clones 4 and 5; different heat treatments of Pommard) in three vineyards. She considers it a workhorse clone and has never seen it perform poorly anywhere. However, she does offer some criticisms: it tends to be masculine with dark fruit; also slightly vegetal and somewhat rustic and aggressive. It makes a good blending component, yet lacks the pretty, elegant, and supple characteristics of other clones.

HARTFORD FAMILY
WINES

Cabral adds that the Pommard Clone performs well in different soil types. He notices greater differences with Pommard in soils than from the actual clonal selections themselves. He illustrates by citing the Rochioli Vineyards Allen Ranch, East Block, West Block, and River Block (which has a younger selection of the Pommard Clone from the West Block, planted in 1988).

Although only a couple of feet from each other, East, West, and River blocks perform differently because the soils are different, which is quite evident in the Rochioli Winery bottlings. Cabral ferments each block separately, attempting to design a wine he views as the best composite.

Allen Vineyard Pommard Clone is extremely delicate and very seductive with strawberry characters, higher acidity, and lower color compared to River Block (less than 300 feet away) with different soils. "One thing to remember," Cabral says, "the vineyards are on the west side of Westside Road rather than the east side. Down by the Russian River, there are loam soils and river rock. There's greater vine vigor yielding darker colored berries and black fruit characters, but lower acidity.

"This example truly illustrates the impact of soil. The sites are farmed exactly the same by Joe Rochioli, who emphasizes a balanced vine. Harvest dates vary within about 10 days of each other."

In 1993, Lynmar undertook an aggressive planting of Pinot Noir. Plant material included the Wadenswil Clone (Clone 2A), sourced from Oregon, along with Pommard and the Jackson Clone 15 (from FPMS, UC Davis), and two Dijon clones 113 and 115. Wadenswil performed unevenly. In 1999, it was dismissed as unsuitable for the climate, and the block was ripped out.

Jackson Clone 15 developed large, elongated bunches. The wine, while not as objectionable as Wadenswil, was nondescript in most years. This clone has also been abandoned.

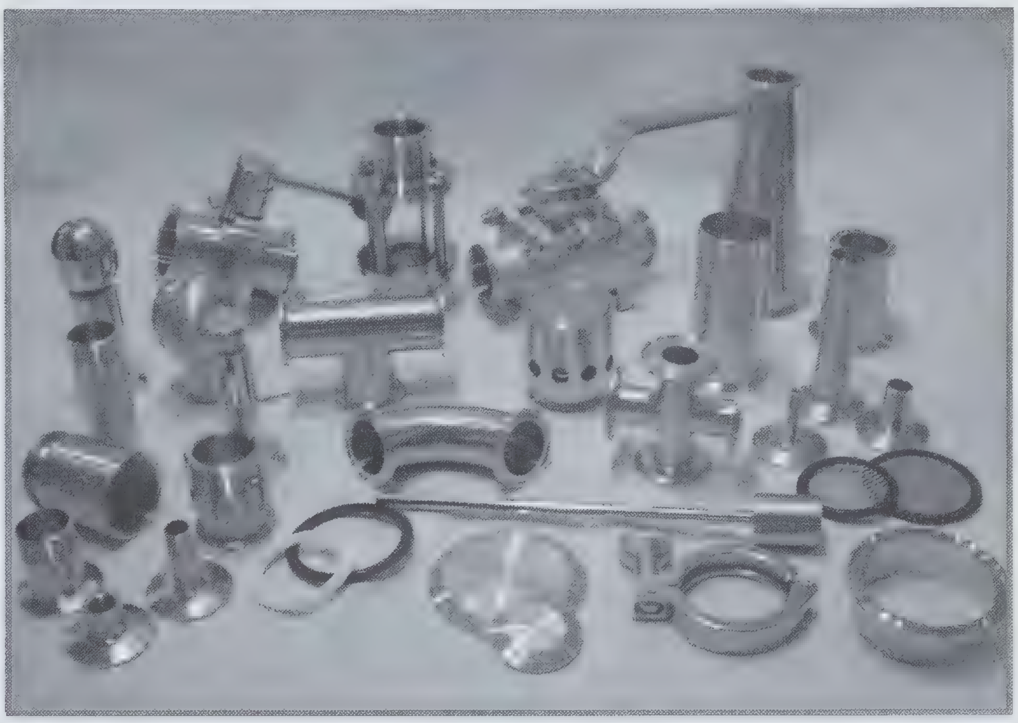
IRON HORSE

Cabral also works with the Canada clonal selection. Parentage for six acres, planted in a Guerneville area vineyard on the edge of the RRV bordering the Sonoma Coast AVA, is uncertain. It is believed to have entered Montreal, Canada, from the University of Dijon and was later propagated by Cornell University.

With small clusters and good color and texture, the Canada selection performs well. Low yields offer high intensity fruit and good tannin structure with soft, black, and chewy fruits in the mouth.

Since 1974, Sayre has worked with the Wente Selection (original budwood from Dale Goode's Hoot Owl Vineyard in the Alexander Valley). With very small clusters, it makes exceptional wine in certain years. "I've made it alongside Clone 2A and it's almost identical," Sayre says. "I call it an ugly duckling Pinot because it's so tannic in youth. Allowed to remain in barrel on lees, however, it slowly comes around."

Like Keegan, Marimar Torres has a selection they originally called Beringer. Technical Director Bill Dyer says it was informally referred to by that name as it was taken from a Beringer-controlled vineyard on Big Ranch Road north of Napa. He has been told it was a certified clone at the time, likely one of the Martini selections, but was later decertified when found to have virus. He has heard it is the same seleciton grown at Cambria Vineyards & Winery (Santa Maria), where it is referred to as Julia's clone.



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"Marimar Torres renamed it the 'Christina' clone after her daughter," Dyer notes. "It has dark skins, yields well, and produces a big fairly tannic Pinot Noir that provides structure in a blend, but doesn't have the finesse to stand alone."

The Swan selection at Marimar Torres Estate came from Dehlinger Vineyards (Sebastopol). "It makes a very concentrated wine, but is not very productive, averaging just over two tons per acre," adds Dyer. "There is also a small amount of Lee clone, taken from Iron Horse, and likely originating in Ira Lee's vineyard in Carneros. It is very productive, and must be severely thinned to make quality wine."

UCD Clone 13, planted at Iron Horse, is a heat treatment of the Martini Clone. It's planted in several sites on the estate. Only the 1991 planting at Thomas Road Vineyard is used for still wine production. "It produces our best wines," reports winemaker David Munksgard. "It's dark-berry colored with mirrored aromatics and flavors. Generally soft tannins, lots of flesh, and good wine weight."

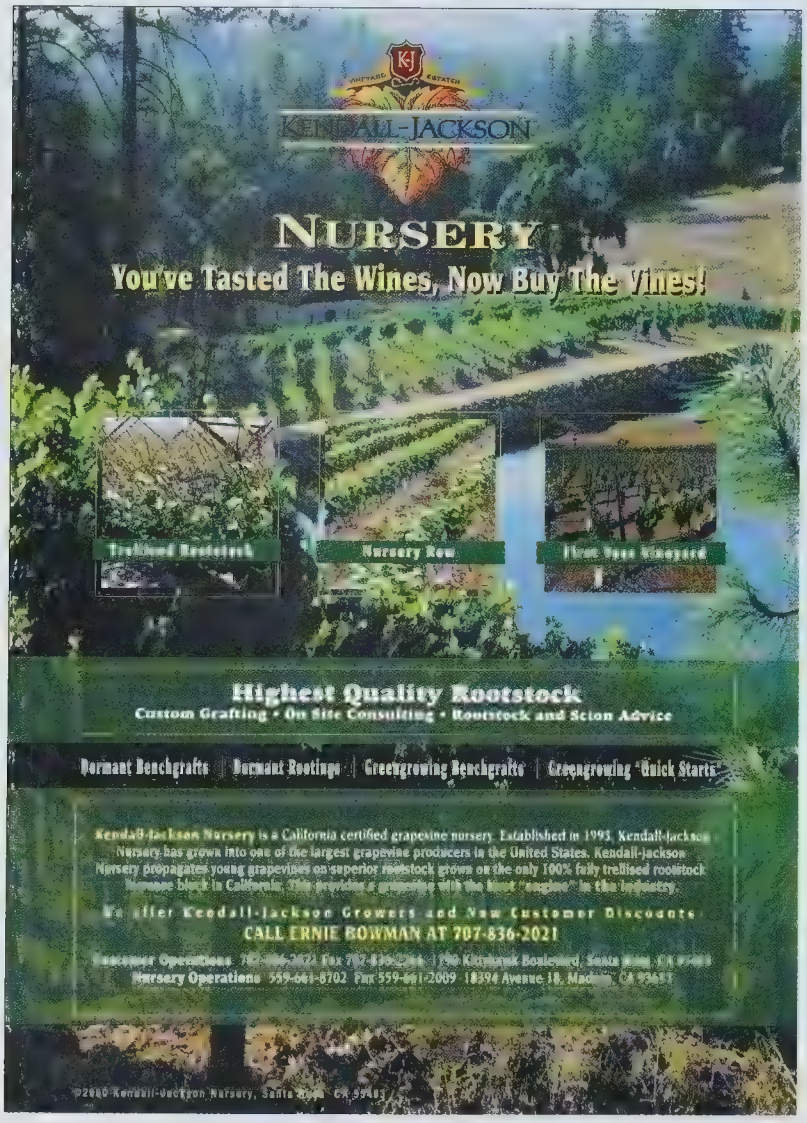
In the same vineyard, the Pommard selection is planted on a sandy-loam, gravelly, hillside location. As a blending element, the fruit offers high-toned aromas with good color (but not as dense as Clone 13). Its drawback is grippy tannins.

At Rodney Strong, Clone 23 is a heat treatment of the Mariafeld Clone. It offers spice cabinet characteristics and creates an age-worthy wine, but it lacks the seductive nuances required for high-quality Pinot Noir.

"The confusion among clones and selections that exists today," Moore contends, "stems from the rush-to-plant era of the 1980s. Vineyard owners took dormants, green grafts, certified, and uncertified plant material from sources perceived to be clean, well-cared-for vineyards. Good records were not maintained. What we also see today is the tendency for Pinot Noir to change as it adapts to a specific site."

Assessing Dijon clones

With the Dijon clones, Shakked maintains that site is important, but



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even on different sites, the same clone has a comparable influence. “Yet I believe growers in RRV should not plant 100% Dijon clones in a vineyard. They were selected for early ripening, and in warmer, drier years, they do not develop flavors with depth, even at 24° Brix. For this reason, later ripening clones are needed in the clonal mix.”

Keegan has Dijon Clones 113 and 115 in experimental blocks that she has evaluated for four years. She maintains that 113 creates a nice blending fraction. Clone 115 (exactly the same age and plant material) is planted in two different vineyards, one in southern Sebastopol and the other off Eastside Road.

“There is no similarity between the way they grow or the way they taste,” she notes. “They are both lovely. Both perform well. I could put them out with five or six wines in a tasting and nobody would say it’s obviously the same clone. Their characteristics are representative of where they are grown.”

Shakked says Clones 113 and 115 perform similarly — both have pleasing aromatics with floral and red fruit notes and not much black fruit. Clone 115 has consistently shown better on the palate with more weight and length than 113. Clone 114 is short on the palate and the weakest. Of the three, he prefers 115.

MARIMAR
TORRES ESTATE

“All that has been said indicates that performance is clearly related to site,” Dyer recaps. “At Marimar Torres estate, I like Pommard (UCD 5) the best, and I rank Clone 115 right behind it. I’ve often heard it said that the Dijon clones ripen earlier in comparison to other Pinot Noir clones.

“I have heard that these Dijon clones ripen too early in California, and are better suited to Oregon and Burgundy. Yet at Marimar’s vineyard, 115 grows side by side with Swan and Pommard. It ripens not more than three days ahead of them and consistently makes outstanding wine.”

On Keegan’s site in Sebastopol, 115 ripens a few days ahead of Pommard and Beringer. Yet in the Eastside Road location, where it’s warmer, it does not ripen ahead of other clones planted there.

At Lynmar, 115 is well ahead of all other clones in flavor development. “We pick the Dijon clones at 23.0 Brix,” Moore says. “At that sugar level, they are deeply concentrated and retain great acidity. We can be as much as 10 days ahead with this picking compared to the rest of the vineyard. But there’s a big wild card in this admission. The rootstock is St. George.”

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Keegan is fond of Clones 667 and 777. Although 777 is a French A selection and 667 is a B, she has not found them so dramatically different that she would classify them as such. Both are in the Eastside Road vineyard. Cropped to 3 TPA, they perform beautifully, with 777 exhibiting a slightly broader spectrum of dark fruit aromatics than 667.

An analogy

To explain grape farming for top quality, Chavoor uses a sailing analogy. "Sailors are always looking for the wind. I judge wind by turning my head until the wind hits both ears. Then I know from which direction it's blowing. That's what it's like when you're dealing with vineyards. You're always turning your head to see where you are. You have to do that with each block, each variety, and each clone. You have to be there and keep your eyes open. And you have to do it frequently. Being on time to see changes is a necessity."

McIlroy insists Pinot Noir must be babied. "We've discussed different clones, multiple sites, different soils, and impact of rootstock. In order to pick grapes at the appropriate maturity, each block must be monitored. A grower cannot rely on a sugar test or vineyard history alone.

KEEGAN

"Every season is different. There are a number of visual symptoms, especially when the vines begin to defoliate and leaves begin to yellow. Another sign is wrinkling of berries in the cluster. That's when intense flavors are apparent.

"It's also important to use small fermentors. Special vineyard portions must be isolated for fermentation. That's the nature of Pinot Noir. It's so hard to deal with because there are so many factors. There is one constant, however. Great vineyards are consistent."

Training and trellising

For the Rodney Strong vineyards, McIlroy prefers bilateral cordon. It causes development of smaller clusters, but not necessarily a more uniform crop. All sites have been retrofitted to a vertical shoot-positioned trellis (VSP). Rows are oriented north-south and drip irrigated. Typically, he says, a split canopy is not ideal for Pinot Noir.

On the other hand, Chavoor prefers double Guyot. Most plantings are 5x8 and 6x8, with 1,100 to 1,200 vines/acre (VPA). He prefers cane pruning. He believes it offers greater flexibility and allows the grower to produce a crop that will ripen more uniformly.

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With double Guyot, it's simpler to achieve uniformity of shoots and adjust canes to vine vigor. A cordon is locked in. Management becomes an issue because skilled field hands are required to cane-prune correctly. But the principal advantage of cane pruning is flexibility.

Moore notes that herein lies a difficulty with Pinot Noir. It's not the vine or grape itself, it's the crew members hired for the vineyard. They must be skilled.

"It's not so much that Walt (Chavoor) and I disagree," McIlroy explains. "It's more a matter of the location of our vineyards. Rodney Strong's vineyards are located on the warmer side of RRV, whereas Chavoor's are on the cooler side.

"Due to bud fruitfulness, cane pruning is the method of choice for cooler climates. As far as wine quality is concerned, Pinot Noir is the most yield-sensitive variety. I prefer cordon pruning for the vineyards I manage because smaller clusters develop and therefore a smaller crop.

"In a cooler climate, a sufficient crop may not develop consistently, unless the vines are cane-pruned. Walt's correct. If skilled labor is available and it's managed correctly, crop can basically be adjusted as needed. Cane pruning is more flexible because canes promote bud fruitfulness needed in cooler areas.

"Yield sensitivity is site-dependent. Although yields of 1.5 to 2 TPA are considered too low, no person in this discussion would say 5 TPA or higher gives significant quality."

With cordon training, the fruiting wire is at 30 inches above ground. Yet, Chavoor is not sure that's the best height for quality. But it is for labor.

Moore references the Burgundian preference at 18 inches above ground, and he questions the carbohydrate storage theory, suggesting that with a shorter trunk there's less carbohydrate storage, and asks how much difference can 12 inches really make?

McIlroy doesn't buy the theory suggesting that roots are a huge source of carbohydrate storage. On a vigorous site, there's a massive root system, capable of storing carbohydrates, regardless of whether it's cane or cordon.

"But that's where rootstock selection becomes a priority," Chavoor adds. "The proper rootstock aids vine balance."

Picking maturities

Participants state Brix range between 23.2º to 26º at picking. The pH has a window of 3.2 to 3.59, although TA ranges from 0.6 to 1.0.

Cabral explains that cooler areas definitely have higher acidity and lower pH. His concern is balanced juice going into the fermentor. At a TA of 1.0, there may be 450 mg (and as high as 500 or 600) of malic acid. "Believe it or not," he reports, "I end up acidulating these wines with tartaric acid during fermentation to create balance in the final wine. Otherwise,

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pH will be extremely high in the finished wine.”

Munksgard explains that although Iron Horse Winery is in a very cool area, most of the Pinot Noir comes from the Thomas Road Vineyard (highest, most westerly ledge on the property), which is cool, but the fog lifts early in the morning compared to the estate vineyards.

“We do get high malic acid levels that cause us to delay picking our grapes in some years,” notes Munksgard. “Even if we end up with high Brix levels, I wait for the pH to rise. In certain vintages, we do have dramatic shifts in pH, as Bob (Cabral) described.”

At Marimar Torres estate, TA is generally in a range of 0.6 to 0.8. Malic acid is generally between 30% and 40%. Acidulation is usually not necessary, but will occasionally be done to counter high pH..

Cabral suggests that such phenomena require tasting the fermenting juice a couple of times each day. His regimen begins with a 6 AM tasting of every fermentor before the cap is punched down. “I’m not sure,” he adds, “that it makes a difference when tasting is done, but the timing of acid addition is critical. If done between 15° and 20° Brix, I use a lot less acid and I reduce radical pH shifts; the acid holds better, creating better balance.”

Irrigation and fertigation

Sayre and McIlroy have studied the issue of irrigation schedules as a potential control for dramatic pH shifts.

McIlroy notes that vigorous vines tend to raise the pH and TA at the same time, which means juice will have elevated potassium ion (K^+) levels, creating problems in buffering and adjusting the pH.

Because Pinot Noir is an early-ripening variety, the pH rises quickly. If the vineyard is vigorous, a grower fights that rise, as well as the variety, and may be struggling with soils and climate at the same time. If the vineyard is over-irrigated or over-fertigated, vigor is exacerbated.

If the canopy and/or rootstock are too vigorous, the must can have a high pH and a high TA. This makes lowering the pH almost impossible due to buffering of the must because of the potassium level. It leads to wines that are less stable and lower in color. Therefore, one should be careful not to pick a vigorous rootstock or over-water and fertilize Pinot Noir.

“If irrigation and fertigation are managed correctly, a grower can overcome some of the problems,” McIlroy contends.

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Cabral suggests that this is when rootstock becomes the umbilical cord. “It will aid in pulling moisture out of the soil. Clone topwood does not matter as much as the proper rootstock. If the rootstock is not matched correctly to the soil and in sync with irrigation schedules, it does not matter what the neutron probe is reading. Just because a neutron probe indicates there’s water in the soil does not mean that it’s available to a particular rootstock.”

The term irrigation reflects a fine line of how often water is applied, the vine’s actual needs depending on the soil, and particularly the rootstock. If deficit irrigation is practiced too rigorously, the vine may never catch up once water is again applied. That’s when high pH and high TA situations develop.

“I don’t think we put sufficient emphasis on the soil moisture and importance of the rootstock over the clone,” Cabral contends. “On a scale of 1 to 10, rootstock is a 10 in importance and clone is 1 or 2.”

“The best vineyard managers,” McIlroy notes, “can look at vineyards and tell when they need to be irrigated. The neutron probe is simply a tool that may help predict timing with the pressure bomb being the best analytical approach. It is possible that the visual

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symptoms of the vineyard are opposite of what a neutron probe is indicating.

"The front half of a vineyard may be vigorous, and a neutron probe indicates irrigation should be done. But the vines are growing like crazy. The back side of the same vineyard may be a cobbled area and the vines are showing stress, yet the neutron probe may indicate that's not the case. Irrigation must be managed based on visual symptoms also."

Cabral believes it's a winemaker's responsibility to help the vineyard manager. "He should also be out there looking. If shoot tips start curling over, it may be too late to productively irrigate."

Munksgard believes the challenge of Pinot Noir irrigation is probably the single largest issue keeping Iron Horse from stepping up wine quality.

"We hit this period near each harvest," Munksgard says, "where the Pinot Noir just started to raisin, almost overnight. We simply didn't have the 'ears' that Walt (Chavoor) was talking about. We didn't know where to look. We didn't know how to look. Now, we're learning that.

"What we're doing now is looking at the angle of the leaves; observing overall color changes in the leaves — trying to pick up all the signals. We dig holes to assess water needs. We're more conscious about looking for handles."

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Practicing what works

Chavoor reiterates the prime factors: soils, climate, and clones. "One of the first things we learn in practical viticulture is that everything is site-specific. It's sexy to talk about Pommard or 667, however it's their relationship to a particular soil and climate that makes so many unique and great wines from only a few clones.

"I think we spend so much time talking about clones only because we understand the vocabulary. It's harder to grasp complicated geology and climatic nuances. That's where growers and winemakers must use their ears."

"To judge irrigation needs, we began with digging holes with a backhoe, or perhaps, if a grower spent many years farming the same property, he understood what to do. There is no substitute for this kind of farming. Today, we've gone from that to tensiometers, gypsum blocks, to neutron probes, C-probes, and infra-red detectors. None of these methods really work.

"A hand probe works. Depending on soil composition, punch the probe into the ground as deep as needed. Pull up a soil plug. Feel it. If it's wet, water is not needed. It's fool-proof."

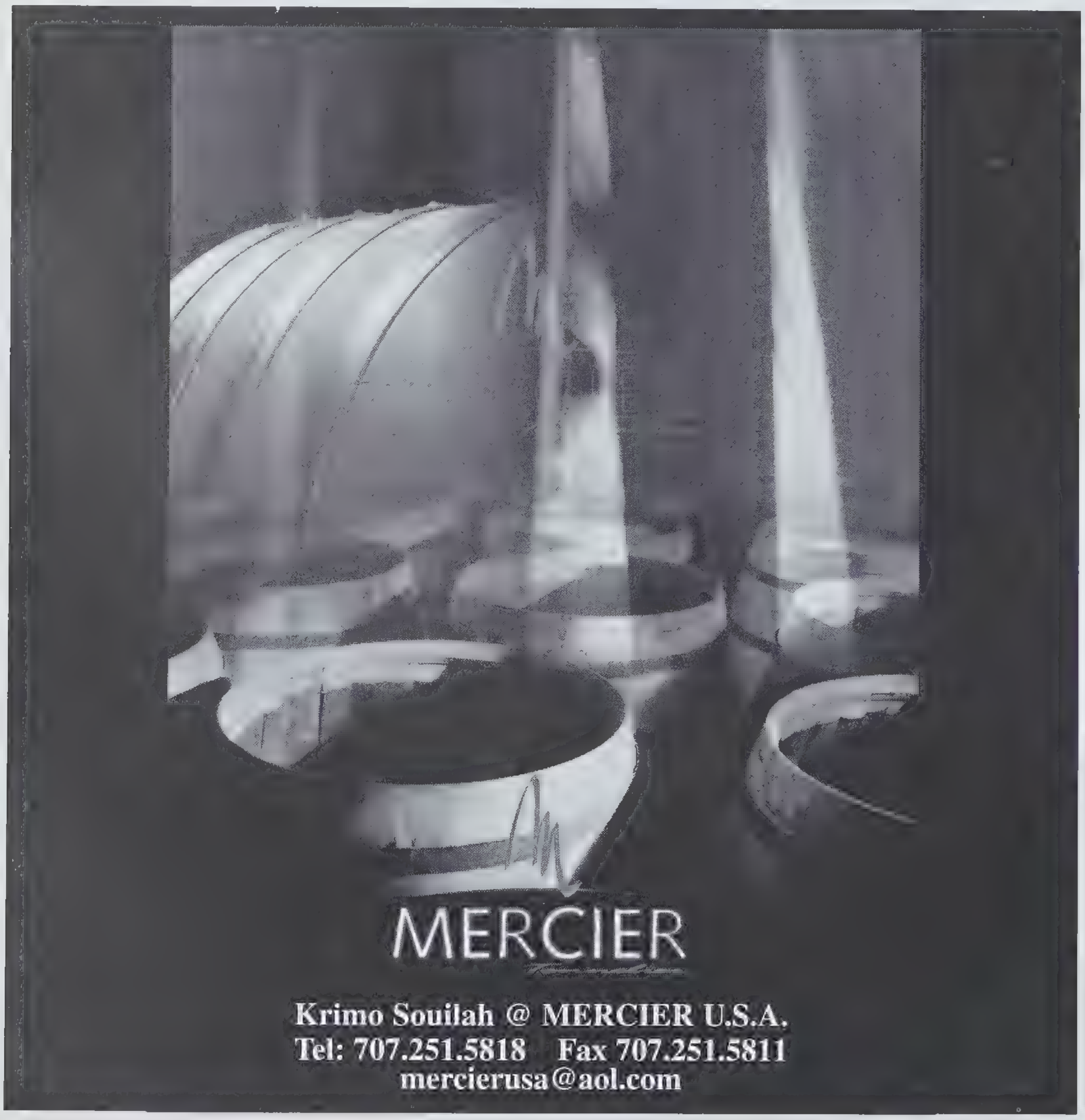
McIlroy cites some irrigation strategies that are typical of viticulture today: water a few weeks before bloom and give another good shot right after bloom. To minimize berry size for greater flavor intensity, a number of growers practice deficit irrigation, particularly between berry set and veraison. Then, during veraison, if the crop is 22° Brix and the temperature rises to 95°F, they turn on the irrigation system.

With Pinot Noir, post-veraison watering is a necessity. Pinot Noir can rise from 22° to 26° Brix in two days. If that is allowed to happen, the best flavors for top quality wine are lost.

Entering harvest, the vine should be in a healthy state. Stressed vines bear stressed fruit. There's still a myth in the industry that watering vines near harvest is a poor practice. Participants say it's not.

Leaf stripping

Radical leaf plucking to defend against bunch rot is a thing of the past in the coolest RRV areas. This opened up the vine too much. The afternoon side of the vine is now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considered sacred. Leaf pulling on that side will cause bunches to bake and berries to dessicate. Today, participants open up only the morning side of the vine.

Moore believes that since leaf pulling has been considered insurance, most growers over-insure. Denuding the fruit zone is craziness and the kiss of death for Pinot Noir.

Basically, says McIlroy, growers learned that excessive leafing is detrimental to red wine quality, especially Pinot Noir. To retain good color, he suggests not more than 40% to 50% fruit exposure.

That's why he considers VSP the ideal way to grow Pinot Noir. Spur positions on the cordon can be spread far enough apart to lessen the number of shoots per meter. When the vine grows to the top of the trellis, it will stop and reduce the growth of laterals.

"If shoot thinning is done early on, then by nature of the trellis and balance of the vine, leaf pulling should not be necessary," McIlroy concludes.

Chavoor adds that about 15 years ago, leaf pulling began as a response to the "California sprawl." Canopies had to be opened. It was band-aid therapy. The real solution was a vertical trellis. "Somewhere between then and now, we've forgotten why we were pulling leaves," he suggests. "Now we have vertical systems and we're still pulling leaves."

Another reason leaves were pulled was to allow penetration of sprays into the canopy. New electrostatic sprayers achieve spray penetration without leaf pulling. This is an economic issue because it's expensive (about $100 per acre) to pull leaves correctly.

Dyer suggests vine row orientation as another factor impacting high quality. In the RRV, vine rows planted in the northeast-southwest direction offer the most protection against sunburn.

However, Shakked notes that such directional planting needs modification where Russian River flood waters may flow. Otherwise, an entire vineyard could be flattened in a flood.

Prefermentation maceration

All participants conduct a two to eight-day fermentation. Munksgard uses dry ice to help cool down prefermentation maceration temperature. It also depletes oxygen in the must. That, along with an SO_2 addition assists in delaying the start of fermentation.

To keep lactobacillus at bay, 30 ppm is deemed an appropriate SO_2 addition, but the range is 0 to 50 ppm among participants.

Prefermentation maceration, Munksgard believes, offers water-soluble pigments and flavor compounds that are retained in the wine.

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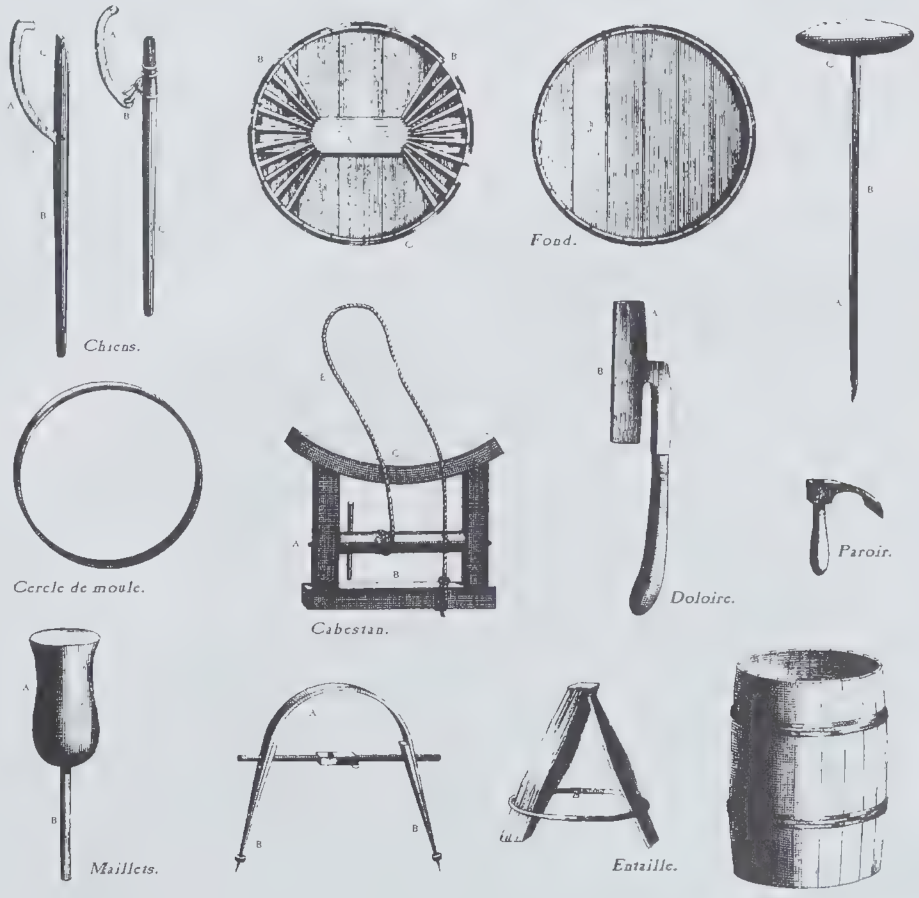

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Sullivan adds that's only a fraction of the benefits of a cold soak. He believes it has more to do with overall fruit profile and the fatness and body of the wine.

Cabral says that fruit can be held too cold during cold soak. He suggests about 55°F is best. At that temperature, there is higher enzymatic activity involved in breaking down complex carbohydrates and proteins. To him that's what a cold soak accomplishes.

Did enzyme addition do this in a former era? "Enzyme addition accelerated that," he responds, "and perhaps too fast. Here's the question: if you have a 20-carbon chain carbohydrate, is it best to break it up four carbons at a time? Does that offer a fatter mouthfeel or would it be better to break it up in eight carbons at a time? I don't know, but I've found that a cold soak makes the mouthfeel lush, fat, and round. It establishes softer tannin and greater flavor integration in the wine, even before the yeast has had a chance to metabolize carbohydrates."

Moore defines cold soak as an enzymatic prefermentation, occurring before other biological influences take it the next step. It's the "other biological influences" that remain unknown factors.

Destemming/crushing operation

At Williams Selyem, the fermentor bottom is lined with 10% to 20% whole clusters. Destemmed berries fill the remainder. Sometimes, Cabral notes, it has been difficult to get sufficient juice because there are so many whole berries.

His ideal destemmer/crusher is constructed with independent paddle speed to rotating speed of the basket. This determines at what force the berries are thrown out against the drum. "We have the technique down to a science," he explains, "but the biggest problem is jacks (lacerated stem pieces)."

Some years there are more jacks, and in other years they are non-existent. Moore questions whether it's nutritional imbalance or another factor.

Cabral has noticed that Central Coast fruit does not have as many jacks. The stem separates from the berry, even though stems taste far less mature than those from RRV.

Fermentors

During fermentation, Cabral wants to keep as much of the cap in contact with juice at all times. To accomplish this, his ideal tank construction is two, or if space allows, three times wider than tall, to prevent formation of a big, thick, dried-out cap.

There's significant heat build up, Sayre says, because Pinot Noir ferments so fast. Tank construction for ease of cooling is important to him. Using rotary fermentors, he's learned that larger ones are a huge mistake for Pinot Noir because they cannot be cooled quickly enough in relation to the rate of fermentation.

Sayre's conclusion: the size of the rotary must be less than 20 tons. Cold soak slows down fermentation, so it's another reason to practice it. Must, as Munksgard mentions, should not be aerated, otherwise fermentation rockets. For the same reason, he does not recommend adding a yeast nutrient.

"Pinot Noir," says Sayre, "has just about every amino acid available for proper yeast fermentation. Even if there are indications that we should, we don't add DAP. It, too, causes a rapid fermentation."

Participants differ on the ideal maximum fermentation temperature. Sayre prefers to start it cold and then have maximum reach 85° or 90°F, which participants believe is the upper end of the maximum range.

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Munksgard's maximum juice temperature is 70°F. Because available tanks do not allow punchdown, a portion of the juice is drained and gently sprinkled back over the top. Since the temperature is dialed low, cap temperature does not rise quickly.

"Rick (Sayre) lit on something," Munksgard adds, "that goes back to cold soak and what is really going on inside the fermentor during it. My standard operation used to be when I added the yeast, I added DAP or Fermaid. I've backed off on doing that. I believe what's happening is that during cold soak, an indigenous yeast population builds up. The minute the must begins to warm, they are off to the races. They rob the must of the necessary nutrients at that time.

"What I'm doing now after a seven-day cold soak, is inoculating, simply because I don't have the guts to wait for a spontaneous fermentation to begin. I make nutrient additions on the second day into the fermentation. At that point, I'm comfortable that it's the yeast culture that I've added that's being fed.

"If bacterial fermentation starts, Pinot Noir stops fermenting. I draw off early by taste, generally in the range of 5° to 10° Brix, and transfer the wine to freshly-ozonated barrels. I do this because I've had occasion where barrels literally stopped primary fermentation and finished malolactic fermentation (MLF), then MLF bugs went to work on the remaining sugar. That's not something you want to have happen."

For Moore, the issue is nutrients in the last growth cycle. "Everyone is chasing unfiltered bottling," he contends. "At what level of residual sugar can you safely bottle unfiltered? I'm unsure. That's why getting wine as dry as possible before transferring it to barrel is a big issue for me."

Barrel ageing

In most years at Lynmar (except for 1999, a big, extracted vintage where decisions were made at each fermentor), free run is fractionated from press juice, pressed up to 1 bar.

MLF in barrel is the preferred regimen at Iron Horse. Barrels are filled and transferred to a warm room (65°F to 68°F) where they are vigorously stirred until primary fermentation completes. They are subsequently inoculated for MLF with continued daily stirring for a period of 1½ to 2 months.

All participants are using French oak barrels, ranging from 20% to 75% new.

Is Pinot Noir an oak sponge? Cabral indicates that it depends on the oak and uses only one barrel type (about 200 per year): François Frères, Troncais, medium+ with toasted heads. Lots then vary from 33% new oak to 100%. Decisions depend on perception before the wine is drained and

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pressed. Cabral believes his barrel choice helps mellow and soften tannins in fruit sourced nearer the Pacific Coast.

Dyer uses one-third new barrels with medium+ toasting level from a variety of coopers.

Sullivan adds that barrel choice depends significantly on the style goals and whether production is a single vineyard wine. The desired stylistic influence is also a factor.

Time in barrel among participants runs from 10 to 18 months, with the average slightly less than 12 months. Sayre says taste determines length of time in barrel. Therefore, it varies year to year. If wine is left too long in barrel, fruit levels and color diminish.

A conundrum presents itself in a massively structured vintage such as 1999, which had less fruit forward characters than other vintages. Extended barrel ageing softens tannins, but at the expense of diminishing fruit. Since Moore prefers nuances developed in extended barrel ageing, he's moved away from heavily-toasted cooperage. More moderate barrel toasting integrates better into a desired 16 to 18-month barrel program. If barrels with heavier toast levels are desired, the request is made to put a light toast on the heads.

Going over to the Dark Side

Globally, among the most hotly debated stylistic issues is whether a dark, heavy Pinot Noir style is preferred over a lighter one which showcases elegance and finesse.

"The dilemma," says Keegan, "is this: do winemakers want to make wine for reviewers or for pleasurable drinking and as a statement of site? I've never solved this artistic question in my mind. Therefore I follow my own artistic path and let the wine have its own voice."

Participants stress that the Dark Side is the wrong path for RRV Pinot Noir. Dyer is adamant: "Save dark and heavy for other varieties."

Yet Moore asks, "Isn't there a tendency for Pinot Noir styles to lean more towards Syrah? We all know why. Interestingly, I find that I love to drink red Burgundies, and with skyrocketing prices of domestic Pinot Noirs, I'm actually drinking more value-priced Burgundies. Yet, when the French put forth their more finesseful style, it's expected by reviewers and they score them high.

"In California, when we show a Pinot Noir with finesse, it's not viewed as well because it does not meet so-called expectations. It's produced in sunny California, where we should make more powerful wines."

Distinguishing characteristics

In Sullivan's opinion there are so many sub-regions in RRV that any of them could be archetypal for a consumer, in terms of their preference for Pinot Noir. "I like all the styles," he affirms, "but they are very divergent."

It's always difficult to get agreement about certain descriptors, Dyer adds. RRV is less likely than Carneros to experience late season heat spikes. It always comes down to Pinot Noir requiring a cool region to develop concentration and intensity. Grown in warmer climates, all Pinot Noir offers is a simple, varietal cherry, red fruit identity.

Cabral characterizes RRV Pinot Noirs as round, rich, and concentrated. "What I like about RRV Pinot Noir," he concludes, "is that it's a complete wine. Through various stages of its life, it does not deviate a whole lot. From day one through year-10, it's lush, rich, fat, with both black and cherry-like fruits. They are fruit-forward and more floral. Coastal wines are more spicy, and they pick up sweet herb nuances."

Sayre summarizes: Newer clones are changing the characteristics of RRV Pinot Noir. Ten to 20 years ago, the Martini Clone was the most-widely planted. Those wines exhibited soft, red cherry fruits, strawberry and rose petal characters. There were no Dijon Clones or 2A.

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Cellar techniques, such as barrel fermentation, lees contact, and MLF in barrel, have made the wines more complex. Today, RRV Pinot Noirs are more subtle, soft, and velvety.

"Granted, on different sites," Sayre continues, "there may be tendencies toward more black fruits with more tightly-knit tannin structure. Santa Barbara and Monterey Pinot Noirs tend to have a stereotypical taste and are usually easily distinguished. Yet, not all of them fit that pattern. It's the same for Russian River Valley Pinot Noir.

"This is almost as touchy as discussing *terroir*."

Chavoor concludes, "That's the beauty of Pinot Noir. Nobody knows all the answers for this grape. I hope that it will always remain an art. It's not like great Rutherford Cabernets — they are a bit cookbook. Pinot Noir will never be cookbook." ■

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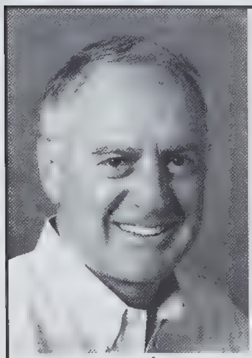

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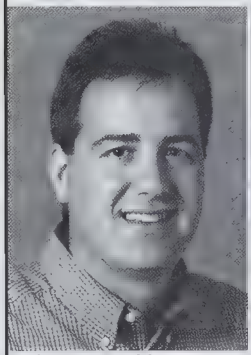

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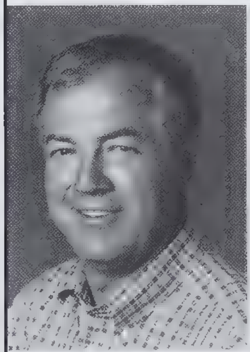

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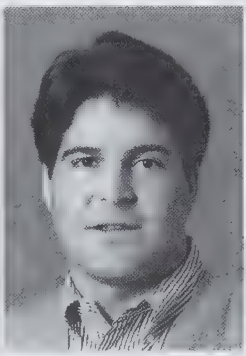

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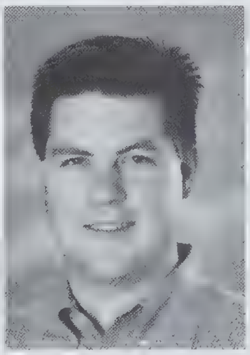

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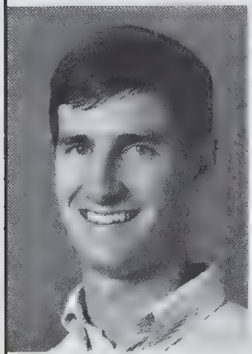

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INSIGHTS INTO BETTER TASTING ROOMS

Buck the economic downturn with special events programs

BY Craig Root

Many service businesses in 2001 have experienced revenue losses due to the souring economy. Tasting rooms are no exception. This article will focus on a number of strategies designed to improve tasting room business and achieve a turnaround.

I was working recently on the startup of a large regional visitor center that planned to pour and sell wines from various wineries, then refer visitors to those wineries' tasting rooms and other area attractions.

Two vital aspects of a well-thought-out tasting room startup are the business plan and the income and expense projection. When I found out that the new facility would be located in an area with no residential houses nearby, but only light, compatible industrial facilities (*i.e.* no rendering plants), I felt comfortable boosting their revenue projections by approximately 20% — especially since the facility's board was interested in the center hosting a wide variety of special events, including weddings.

Let's look at some of the components that make up a profitable winery special events program.

1. Compliance — Is your local government in favor of or at least neutral about special events? This is a crucial question. In Napa County, for example, regulations make it extremely difficult to get special event permits. In most cases, only the older tasting rooms who are "grandfathered" in are allowed to host certain types of events, such as weddings or private parties.

Many newer facilities can offer only events which are trade-related, such as a distributor lunch or dinner. It's important to test the political waters before embarking on any special event program — especially an ambitious one. You may wish to use legal representation for this purpose, preferably by a firm that is familiar with the local powers that be.

2. Neighbor relations — Neighbors constitute another vital part of the special events equation. You may have noticed in my opening example how optimistic I was for the startup facility based on the lack of residential homes nearby.

Many counties around the U.S. have rules regarding special events. However, they may not have sufficient staff to police and enforce these regulations — until they are asked to respond to complaints from your neighbors.

It's imperative to discuss special events in specific terms with immediate neighbors. Of course, they are going to be concerned with noise, traffic, and responsible hospitality. You should do everything possible to assure them that the events will be held at specific, tolerable times (for example, with no event to run later than 10 PM).

Allay their fears with professional security, responsible hospitality, and parking controls. It doesn't hurt to include these neighbors in invitations to winery special events that are suitable for them to attend, such as your opening party, plays, concerts, etc.

You might also consider giving neighbors the employee discount (with limits on amount per year). Just remember that you can have five neighbors who support you, but it only takes one who is negative and determined to upset your plans.

3. Special events coordinator — If you are planning on just a few small special events, your tasting room manager and staff can probably coordinate them. However, if you're planning on a more ambitious, large-scale series of events you'll need an experienced special events coordinator.

Plan on paying this person a salary commensurate with his or her skills. After all, this employee could well be generating revenue into the mid-six figures or more. Plus, he or she will need to have a wide range of special skills, such as food and wine pairing and service; impeccable personal and phone manners; knowledge of etiquette, table-setting and flower arranging; the ability to seamlessly blend house staff with auxiliary help; knowledge of caterers; experience in hiring and coordinating musicians; the ability to remain calm while unexpected calamity strikes in the middle of the event; and the know-how to handle responsible hospitality gracefully (such as guests who have had too much to drink).

This list of skills can go on and on, so be prepared to pay for them and remember that it is a job that can include not only day work but nights and weekends as well. The schedule can be grueling.

I like to see employees receive a base salary plus incentive bonus. Compensation can be based on meeting revenue and cost-saving goals, as well as networking objectives, such as acquiring new destination management companies (DMCs) who will send you new business.

4. Outreach — DMCs usually can be found near any large city or town. When the American Society of Pediatricians is having a convention, these companies arrange daytrips for spouses or evening events for both attendees and spouses.

The beauty of working with these companies is that they generally charge more, based on the high-end services they provide. Your visitors thus tend to be pre-qualified for income and lifestyle factors.

Remember: Just because it's late and the tasting room is closed to the general public doesn't mean the lights are out and the cash register is closed. I've seen large groups buy thousands of dollars worth of wine and non-wine items during and after an event. What's more, your wines frequently show better when paired with great food. Also, most special events mentioned here have some kind of fee associated with the use of your facility.

5. Pricing — To determine pricing, call around and talk with other tasting rooms, facilities such as banquet halls, DMCs, and tour coordinators to assess local rates. You'll be wise to perhaps start out a little lower, then raise your rates once you've established the value of your service.

6. Types of special events

A. Weddings can be extremely lucrative, but they are not for the faint of heart. Nervous grooms and brides, pushy in-laws, all subject to high-pressure indecision — "I want it done yesterday, but I'm not exactly sure what I want!" — these are all part of the stressful world of marriage special events.

Nobody blames the bride and groom, since it is one of the most significant days of their lives. Also, chances are they have no experience booking a site, working with a caterer, or hiring musicians and photographers. These factors will make most people stressed out and potentially difficult to deal with. You'll need an experienced coordinator and staff to hold the hand of the bride and her parents, in particular.

Here are some tips: Plan on lots of time-consuming TLC, so charge more for weddings than other special events. When you have to call the groom's sister in Phoenix "because she took a flower-arranging workshop and knows how the flowers should look," you won't resent it. I've seen the costs for wedding sites range from $2,000 to $10,000.

Stipulate that only your wine can be poured (except in the case of sparkling wines if you don't produce them). This rule is an essential part of how special events can generate great revenues for your facility, because, of course, you will be charging for these wines. Do allow beer, but not hard liquor: intoxication of wedding attendees is a major concern.

All special events should have forms for setting up the event and covering all necessary details. Create a special form for weddings that lists, for example, the photographer's phone

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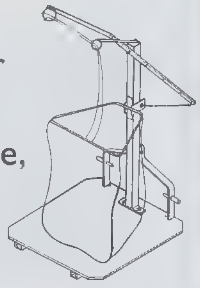
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number or other important information about him or her. Photographers frequently choreograph the event, deciding when it's best to cut the cake or start the bride's dance. Be prepared to coordinate these parts of the event with them.

Above all, try to remain calm in the last stressful days before the event. Remember the old restaurant metaphor of the swan: Below the water, invisible to all, the swan is paddling strenuously, but above the water, where everyone can see it, the swan appears calm and graceful. In fact, this metaphor works well to describe all hospitality management.

B. Other paid, private, special events, such as birthday parties, anniversaries, or DMC groups, usually create less stress. But remember that your winery image is on display, so organization prior to the event is critical. In most cases, including weddings, it's better to build an approved list of caterers with whom you are comfortable. Let the client select the caterer and menu. If there are changes, the client relates directly to the caterer. That way, you don't get the last-minute call that there are four vegetarians attending — the caterer does.

Speaking of caterers, some wineries prefer to use an in-house chef, which has many advantages. For example, the chef can also cook for company events, trade visitors, or the crush crew. However, this practice can be costly, so you need to analyze what's best for your operation — in-house chef or outside caterer, especially if you do not have a commercial kitchen.

Frequently, one of the perks of hosting or attending an event at a winery is the add-on of tours and tasting. Be sure to offer these amenities. People who tour and taste buy more. Plus, if they are willing to spend their free time — when they are most receptive — listening to your message, it's foolish to turn them down.

C. Wine club events are generally charged at a rate that will break even or generate a modest profit. The prevailing concept is that the event is a club perk, for members only and their guests. Such special events can act as an inducement to lower dropouts from the club. Moreover, club members — because of their discounts — frequently make large purchases on-site.

When offering wine club events, it's important to add some variety. Do a treasure hunt, choose a location away from the winery, try a four-hour cruise of a local waterway with food and wine, combine a cooking class with lunch and wine. The list is endless. The point is: If you suggest the same old dinner at the winery every time, people will get bored.

Remember the old 80% – 20% rule: 20% of the people use 80% of the

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services. Some people and couples in clubs come to a lot more events than the majority of the members. One tip is to poll people during events, either verbally or with a small handout, to see which of your new events they are most apt to attend.

These events are also a good time to uncork some of those older vintages you want to sell. Again, it's a great way to say thank-you to club members and increase sales at the event. I'm very appreciative of wine club members. After all, how many customers say, "Here's my credit card number; send me whatever you feel like"? These folks deserve special treatment. Another tip: Always have as many principals or winery family members as possible at the event. Club members get a big kick out of bragging: "I was at the Franklin Family Winery, and got to talk to (or eat with) Jeff Franklin himself."

D. Utilize a winery open house as an event for a charity. People donate whatever they feel like at the door, and your effort supports the charity and casts you in the light of being a good neighbor. The charity itself may even provide donated labor. The goal with open houses is to expose more locals to your tasting room, so use a draw, such as live music and free (low-cost) hors d'oeuvres. See if the musicians will play for wine or money and wine.

Hopefully, you will recoup your expenses and make a profit from extra sales and club sign-ups from vacationers in your area who see the "Special Event, Live Music, Open to the Public" sign. Also, the locals who come will be more apt to refer to you among the other list of recommendations they offer to friends. Be especially sure to invite employees at restaurants, lodging facilities, local chambers of commerce, or other facilities that relate to the public frequently.

There are other special events, such as business or corporate events, where you provide a room for meetings part of the day and offer winery activities for the rest of their visit. Or maybe you have the room to host your area's annual Shakespeare Festival, which will draw a wine-friendly crowd. The list goes on and on.

The point is: If you have experienced a loss of revenue this year, you can simply accept it — or do something about it. Special events are one way to do the latter. ■

Please look for future articles in this series. If you have comments or suggestions, feel free to call author Craig Root at 707-963-7589.

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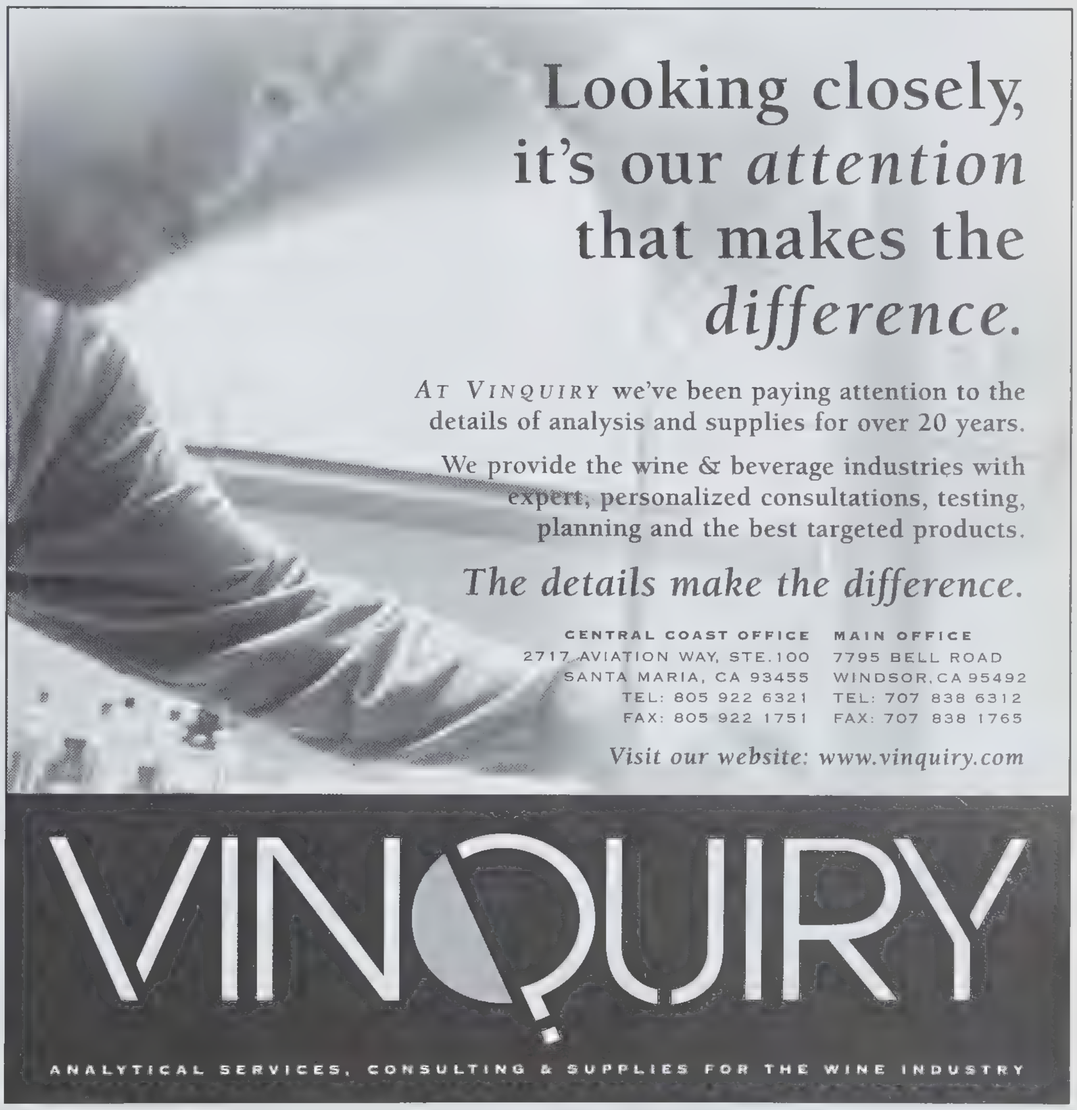
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OVERVIEW

Brettanomyces bruxellensis occurrence, growth, and effect on wine flavor

BY Torey Arvik[1], Thomas Henick-Kling[2]
[1] Doctoral Student, Cornell University Enology Group, Cornell University, Geneva, NY
[2] Associate Professor for Enology, Cornell University,New York State Agricultural Experiment Station, Geneva, NY

Brettanomyces bruxellensis can make some red wines smell like a horse blanket that has been stored in a metal Band-Aids® box. Any, or a combination of all, of these flavors and aromas can be found in affected wines harboring this yeast. *Dekkera/Brettanomyces* has been known to inhabit many specialized environments including tree sap, dairies, breweries, and most notably the winery environment.[1]

There are currently five accepted species of *Dekkera/Brettanomyces*: *D. (B.) bruxelllensis, B. custersianus, D. anomalus, B. naardenensis,* and *B. nanus.*[3] These genera were re-classified from multiple isolates after having been given various synonyms throughout the history of mycology. Conserved gene sequence analysis and traditional biochemical tests were recently used to re-classify this group.[4]

What is the difference between *Brettanomyces* and *Dekkera*? To answer this question, one should know a little about yeast sex.

Dekkera, which makes spores when times get tough, is the "perfect" sexual form of *Brettanomyces*, mycologically speaking. Thus, the reader will often see the name *"Dekkera/Brettanomyces"* in the literature to describe this duality.

Let's just focus on the term *Brettanomyces*, since only a few fortunate people have been able to get the *Dekkera* form from a wine.[7] *Brettanomyces bruxellensis* has supposedly been isolated from a 10-year-old wine! Not surprising if you are a microbiologist, but winemakers bristle at the thought.

Amazingly, during the time that they are in barrels or bottles, *Brettanomyces* can ferment small amounts of sugar if given a small amount of oxygen. Supposedly, *Brettanomyces* grows actively in wine for a relatively short time, although, to our knowledge no basic research has been made evident to tests this hypothesis directly. *"Brett"* cannot actively grow forever.

However, there is a hypothesis that *Brettanomyces* (like many other microorganisms) can remain in a viable but non-culturable (VNC) state for long periods of time. In this state, cells that cannot be observed by standard culture methods continue to metabolize nutrients from their surroundings and are thus still considered alive. This is quite common for specialized microbes that are considered human pathogens and has recently been illustrated in wine bacteria.[8]

That being said, what about the *B. bruxellensis* isolated from 10-year-old wine? Quite likely, they were either spores or they were VNC cells that were in a sort of environmental "stasis." Either physiological state will theoretically remain viable for many years under the gentle storage conditions of a fine red wine. They emerge when cultured on rich media as normal colony forming units. That is, when they are signaled by good nutrition and suitable environmental conditions.

What is "Brett" doing in my wine?

Until recently, saying the word *"Brett"* in the company of winemakers was equivalent to making disparaging remarks about their parentage. Now, it seems winemakers are willing to discuss the issue less defensively. After all, there are some very highly regarded red wines, which are excellent examples of "Brettiness" by virtue of their specific aromas and flavors. Winemakers are learning to recognize these complex aromas and understand how they are formed in wine. With this new understanding of the ecology of *Brett* and the formation of off-flavors, it is hoped that winemakers will be better able to control formation of these flavors in their wines.

Most wineries have had experience trying to control *Brettanomyces* in their cellars. Several wineries we have worked with swore us to secrecy about their "contamination problem." Some said that they had been "working with *Brett*" to make more complex wines, but now, it was just an overwhelming problem in some of their reds. One project in particular identified two *Brettanomyces bruxellensis* strains indigenous to the winery that alternated in three vintages.[1,10]

Recently, the atmosphere surrounding *Brettanomyces* in the wine industry has undergone a change. Wine writers have been chiding California winemakers for being too "hygienic." Some have gone so far as to say that *Brett* odors and flavors in wine are more desirable than not, as evidenced by the exorbitant amounts of money paid for bottles exhibiting the "classic character of a standard Bordeaux." The debate has begun and winemakers we have worked with are not excited by the potential loss of fruitiness and varietal aromas to an easily amended issue.

What is the history of Brettanomyces?

Brettanomyces species have a long anecdotal history that connects them to various foods. Thus, industry reports offer multiple names (and discoverers) for the same organism over the last 110 years.[1] There are copious reviews in the literature describing the infection of various beverages, specifically beer and wine, containing a haze of yeast in bottles or finishing vessels and a malodorous quality (for red wines especially).[11]

One author described the patented use of *Brettanomyces* for secondary fermentation of specialty beers. The name, *Brettanomyces* was officially given to the "*Torula*-like" yeast that was characterized by N. Hiltje Clausen in 1904 as that responsible for production of the "real type of English beers."[2]

Clausen's story goes like this: British applications of a pure *Saccharomyces* yeast starter culture system completely ruined the flavor of English stock beers. Brewing chemists around the world wondered why the British could not get their act together and produce the same good quality stock ales with the new, improved single-yeast system.

Clausen proved experimentally that *Brettanomyces* was a secondary fermenter in cask, and thus, responsible for production of the typical English stock ale character. The beer is ironically described as "wine-like." Interestingly, home brewers can purchase *Brettanomyces bruxellensis* (a.k.a. *B. lambicus*) strains from yeast starter companies for that same characteristic "vinous" expression of true English stock ales and Belgian lambics.

There are very few positive descriptors given to the individual compounds derived from *Brettanomyces bruxellensis* in red wine. Some of the wine-like qualities of specialty beers are most often described in red wines as "medicinal," "animal," "sweaty sock," "barnyard," "smoky," "metallic," "Bandaid®," and "spicy."[1,12]

However, some descriptors like "clove," "smoke," and "spice" are extremely desirable in the right background of intense or forward "floral" and "fruity" aromas typical of Cabernet Sauvignon, Merlot or Cabernet Franc. In wines of lesser intensity (with less body and extraction), the "brettiness" can be overpowering, and indeed ruinous, to the final product's sale value.[12,17]

Here is another nebulous issue: Few people are able to smell every aspect of the typical *Brett* defects in a red wine. Some sense the purely "medicinal" odor of 4-ethylphenol and little of the "green apple" and "wet goat" aromas of valeric and isovaleric acids, each produced to various degrees.[1,13,17] Still others sense an odor of "animal" and "barnyard."[1,13]

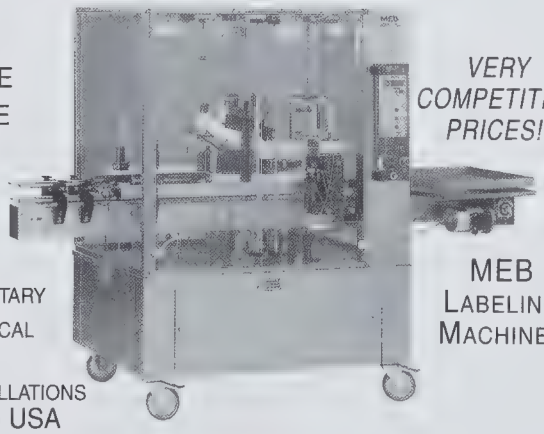
Few people experience the "mousy" or "bread crust" like aromas which are produced by the oxidation of volatile acetyl tetrahydropyridines in the mouth.[14,24] It is important to note that the mousiness of a wine is probably less related to *Brett* than to other bacterial inhabitants but that it is possible.[14]

Paul Henschke of the Australian Wine Research Institute adds: "In all our years of working with mousy wines, we have only been able to smell the [mousy] off-flavor in one catastrophic case, the red wine was incredibly volatile and off-scale for volatile phenols and other microbiological palate strippers as well."

None of the above attributes could be considered positive in and of themselves. However, as stated previously, a complex and full wine background can be enhanced by small amounts of any singularly noxious odor if the context is correct.

This leads one to believe stories told by winemakers when they describe their many encounters with *Brett*. "It just seemed like the strain I had was doing good things to my wines and then maybe I got another strain last year, or something, and the whole lot began to stink." Are there good or bad strains of *B. bruxellensis*?

After visiting with several winemakers at a "Mega-*Brett*" seminar sponsored by Vinquiry in Santa Rosa, CA, in 2001, it appeared that the industry has decided to explore the "good *Brett* vs. bad *Brett*" hypothesis.



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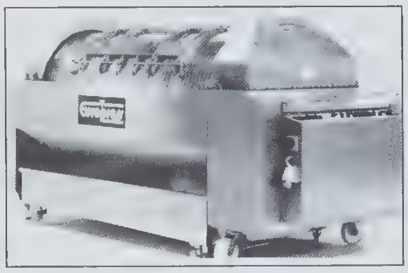

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Our lab and others are currently trying to characterize strains from around the world with several technologies, to see if there might be strains which give a wine desirable *Brett* aromas (smoky, spicy) aromas or simply bad ones.

How does Brettanomyces *do its business?*

Like any good survivor, *Brettanomyces* eats what it finds. As one might expect, the more selective the environment, the easier it is for a tolerant organism to compete successfully with its rivals for limited resources.

With *Brettanomyces bruxellensis*, small amounts of fermentable sugars (0.1 g/L) and high concentrations of ethanol (up to 14%) can act as fuel.[1,4] A little bit of oxygen is also very good for growing *Brett* in wine.[1,4,14] *Brett* can produce 2.0 g/L of acetic acid before growth is severely affected.[16] This is why it is so difficult to predict what will happen to an unfiltered wine in the bottle, which may be complex at bottling, and horrendous one year later!

A major noxious odorant associated with "*Brett*" is 4-ethylphenol. There are at least 10 new odorant compounds that can deliver similar "plastic" aromas including 4-ethylguaiacol, a "smoky," "spicy" odorant in some wines.[1]

Production of 4-ethylphenol from *p*-coumaric acid is completed in a short series of steps. *p*-coumarate is degraded to 4-vinylphenol, a compound with a high odor threshold. It is not uncommon, even for *Saccharomyces cerevisiae*, to produce 4-vinylphenol during active fermentation, just not to the same extent as *Brett*.[13,17] The final step, transforming the 4-vinylphenol form to the 4-ethylphenol form is unique (at least thus far in science) to *Brettanomyces*. This conversion is believed to occur continuously over several months, though nobody really knows the complete physiological picture (for review and reactions see Boulton, R. B., *et al.*, 1996).

Observations in wineries and laboratories have shown that growth conditions, the concentrations of various cofactors, the numbers of yeast, and temperature in the contaminated vessel have a great deal to do with off-odor production.[1,9,10,17]

There are two major hypotheses to explain why *B. bruxellensis* decarboxylates the 4-vinylphenol to the 4-ethylphenol form. One theory states that *Brettanomyces* derives some energy from the transformation in the form of a small electron gradient and thus formation of a small amount of useful ATP. We like this theory since *Oenococcus oeni* does the same thing with the conversion of malic to lactic acid and can derive the same benefit.[18] One might theorize that a H^+ ion gradient might develop and any excess may be "dumped" to gain ATP.

The second theory is that *Brett* is detoxifying the *p*-coumarate via decarboxylation and reduction to 4-vinylphenol. After all, if *S. cerevisiae* does it, why not *Brettanomyces bruxellensis*? There is nothing in the literature yet to support either claim. Thus, this question of "why" is something which needs to be looked into. The bottom line is that more basic physiological work needs to be done on as many strains as we can obtain through the system.

Where is Dekkera/Brettanomyces *found?*

Brett is ubiquitous. That is to say, anywhere in the world that you look for it, if you look hard enough, you will find it. In the vineyards, in water, in soil, in the grape must, in the cold room, fermentation tanks, on concrete floors, and in barrels.

Brettanomyces bruxellensis gets established in a winery when cellar hygiene is not under control, when SO_2 is not used appropriately, when barrels or infected containers are neglected and allowed to absorb oxygen from the air. *Brettanomyces* are unique in that they utilize the "Custer's effect," a means of completing alcoholic fermentation in the presence of a small amount of oxygen.[1,4,15]

We must not forget the fungistatic effect of SO_2 on *Brett*. Maintaining 80ppm total SO_2 ($\leq$ pH 3.5) will keep *Brett* from growing. Also, temperature is critical. Growth is much faster above 20°C and essentially stops below 8°C. Filtration can physically eliminate *Brett*. Part of the larger problem of *Bretty* wine is that some winemakers are following fashion and bottling wines without filtration.

Brett can be monitored, but not controlled. Barrels that are not monitored and topped up frequently are susceptible to blooms of *Brettanomyces*. As far as what to do about this, winemakers may want to consider what has happened with the European livestock industry.

When you go to Europe now, you may be asked to walk through a disinfectant shoe bath to prevent the spread of viruses and other potentially harmful organisms that you might have dragged in. The same should go for the winery, especially in the cellar. Think of where that visitor's feet have been and then ask him to bag his/her shoes.

When a hose is used to clean the floor of juice or spilled wine, aerosolized microbes travel through the air and onto the wall, barrel, or transfer hose next to it. They also travel when winemakers visit sites heavily contaminated without disinfecting their shoes and changing clothes before working with wine.

We are not suggesting that wineries should become clean rooms. However, a little advanced thought and precaution may help to lessen the incidence of contamination. One day, work in the winery, the next day, work anywhere you like, but do not enter the cellar after handling other equipment or visiting another winery or grapes without breaking the cycle for possible entry of organisms into the winemaking areas. *Brett* will come in on grapes and be killed by good vinification and sanitation practices. There is no need to introduce yeast from your friend's winery to yours.

There are indications that *Brett* comes into the winery with the grapes. The fact that it is present in low numbers makes it difficult to isolate, but given enough time, a few are enough to grow to numbers large enough to cause problems. Likely more common is entry with wine or barrels from other wineries.

The most important issue is that *Brett* seems to bide its time waiting for a good time to emerge. A small population of *Brett* might be waiting in a barrel or somewhere else in the winery environment, waiting for the right conditions to grow!

If you are dealing with *Brettanomyces* infections in one or two barrels, isolate them and use different dedicated equipment (if possible) to work with them. If you can, filter the wine in the barrels and clean the barrels prior to dosing with sulfur. You may want to store the filtered wine in something else for a while and perhaps consider using it (after it is verified stable) for blending.

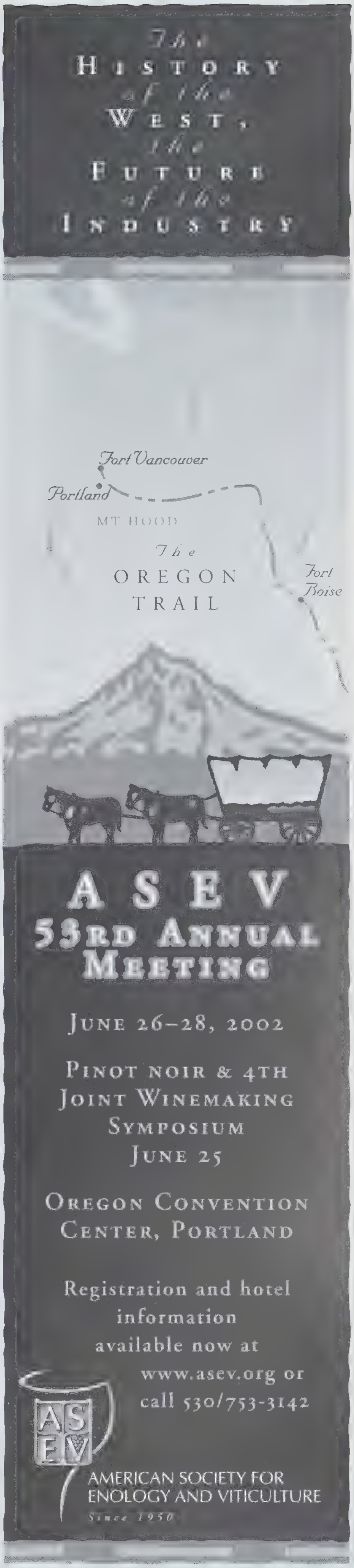
The work of Mark Sefton *et al.* has shown that oak barrels, that are infected with *B. bruxellensis* can not be effectively sterilized.[23] Neither careful washing and rinsing with sulfited water, nor shaving and firing, nor ozone treatment can sterilize a barrel. Due to the large internal volume and porous nature of the oak, not all *Brett* can be removed or killed.[7,23]

NASA shares a problem similar to that of winemakers: when there is an incident in the middle of a mission (or vintage), it can be disastrous and unrecoverable. For this reason, engineers at NASA got together and developed the Hazard Analysis and Critical Control Points (HACCP) program. This is really a philosophy of checking and rechecking valuable points in a system to make sure that there is a recoverable solution, should something fail. Thus, once an infected barrel is discovered, it must be considered contaminated throughout its useful life in the winery. Wine inside the barrel should be filtered, sulfited, and tested for the absence of *Brett* prior to blending away or bottling. Taking a chance to blend away bad aromas is not the solution.

As winemakers struggle with weird contamination patterns, even in the presence of good cellar hygiene, locating the sources of contamination will be too late to be of use in most cases. Use of sterile plastic pipettes in lieu of a single thief would help to greatly reduce the chance for *Brettanomyces* inoculation.

Sampling equipment can be sterilized by boiling for 15 minutes. It can also be sterilized with 70% ethanol. Paul Henschke adds: "…non-'sporing' bugs like *Brettanomyces* can be killed by hot water exposure for 10 minutes or 70% ethanol for 5 minutes (Fitting a condom to the thief is extremely effective for controlling Dekk [sic] infection!!)"

Brett-free wine (filtered, pasteurized, or treated with Velcorin®) for topping barrels will help in the same regard. Keeping barrels topped-up with no



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splashing will delay the growth of indigenous *"Brett"* populations by restricting that extra oxygen they like. The best way to exclude O_2 is to bung tightly and leave the barrel alone!

That brings up another point: to micro-oxygenate or not? Well, Dr. Ralph Kunkee (UC Davis) and a few other microbiologists who know *Brettanomyces* would advise strongly against it, unless you had a very good monitoring program for things such as 4-ethylphenol, 4-ethylguiacol, and plating on specialized media. Wine testing laboratories usually provide this for a moderate fee.

Unfortunately not all *Brett*y aromas and off-flavors can be detected or monitored in the same way as 4-ethylphenol and plating is often too slow. Therefore, new methods need to be developed to prevent *Brettanomyces* growth or to detect them in a viable state early in the wine's storage.[23]

In our experience, we could not correlate the concentration of 4-ethylphenol directly to numbers of viable *B. bruxellensis*. Nor could we rely solely upon the inability to detect 4-ethylphenol to verify the absence of *Brett* in a survey of local wines. We do however favor this method as a proactive measure to monitor the alterations an active population of *Brett* can incur on a barrel over time.

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Effect of Brettanomyces *on wine aromas and flavors*

Primary effects observed in wines infected by *Brett* include a loss of fruitiness and an increase in the overall complexity of the wine in the short term. In the long run, increases in noxious aromas, such as Band-Aid®, creosote, burnt rubber, and a general loss of fruity and floral aromas is apparent.

In a study at a prominent California winery, three vintages were followed for development of brettiness and the alterations of other components in wine. Most significantly, the aroma and flavor compounds associated with varietal impact suffered the greatest conversion to noxious compounds.

Cinnamic acids (such as *p*-coumaric) can add to the floral and "honey-like" aromas of wine. Since *Brett* converts these compounds to stay viable in the bottle for a long time, it makes sense that those delicate aromas would go away with prolonged *Brett* activity. Gas chromatography-olfactometry (GCO) showed just this effect at the winery mentioned previously. Medicinal and metallic aromas and percepts replaced the floral ones.[1]

There are different degrees or types of brettiness in wines. Not all *Brett*-defects are noticeable to all people. Some people have an anosmia (inability to smell) to the "animal" and "barnyard" attributes that are common to affected wines, some are more sensitive to the "plastic" aromas (such as 4-ethylphenol). Both groups of chemical compounds have very different odor thresholds, and most people do not have the receptors to detect them all.[1,21]

It is also important to remember that several compounds determined to be in *Brett*-affected wines were shown to have similar "plastic" aromas yet very different detection thresholds in taste panels.[1] The odor threshold of 4-ethylphenol in water is approximately 50 ng/L. That of 4-ethylguaiacol is 500 ng/L. In concert with other odorants with similar thresholds, there is an additive effect for the taster in a wine. *Brett* can be a very complex phenomenon in rich wines.

"Mousiness" is another attribute blamed on *Brettanomyces bruxellensis* and on some *Lactobacillus* bacteria. A "mousy" wine is detected as an aftertaste, not as an odor. "Mousiness" is created by isomers of 2-acetyl-tetrahydropyridine and 2-acetyl-1-pyrroline, which are oxidized in the taster's mouth and are experienced retronasally.[14,24] These compounds are commonly associated with bread crust, stale popcorn, and mouse urine.

The odor threshold for the 2-acetyltetrahydropyridines is approximately 1.6 ng/L! Moreover, Dr. Paul Henschke and coworkers have shown that all *Brettanomyces* and *Dekkera* species tested can produce mousy off-flavor as well as acetyltetrahydropyridines.[24]

What does the future hold for Brett?

Within the next five years, a molecular detection method will be developed that will yield enumeration results in one day. Our laboratory has continued to develop methods for this purpose. Currently, work is being done on probes that are specific to *Brettanomyces bruxellensis* gene sequences having a claimed specificity of 100%.[22]

There are problems with detection of any organism when using DNA methodologies. One problem is that DNA is relatively stable (and so are some types of RNA). If these molecules are detected and no viable cells of *B. bruxellensis* are actively changing your wine, then you have a false positive result. Meaning, *Brett* looks to be there, happily altering the fruitiness factor and it really isn't.

DNA technologies are so sensitive that false positives are a real issue facing developers of molecular detection methods. However, traditional plating methods can yield false negatives just as easily (*e.g.* non-growing *Brett* don't make colonies on a plate but they do metabolize cinnamic acids).

Another big issue is who will pay for it? When one considers that a barrel of wine may be worth $4,000 or more, a $50

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bi-monthly test to detect and enumerate *Brettanomyces* prior to any perceivable off-odor and flavor problems might be worth just as much. The cost of the equipment to do such work would be great at first, but detection of *Brett* in barrels prior to sensory threshold via chemical and molecular methods might pay off in just a few years! Look for such services at commercial wine labs soon.

The wine industry has been slow to adopt molecular typing and detection methods. Wine producers haven't had to because microbes, which survive in wine are not pathogenic. The food industry has borne the brunt of the expense in development of standard protocols and equipment. Now we have a golden opportunity to use these methods if we can overcome the cultural inhibition and cost limitation that prevent their everyday use with wine.

Finally, we think someone needs to look at the ability of the enzymes responsible for conversion of precursors into unpleasant odors in a test tube. What really does happen when *Brettanomyces bruxellensis* yeast cells rupture and release all of their contents into the wine? Can the enzymes that were once contained within the cell now continue to alter the wine in the same negative way? For how long does this happen? That idea sends chills up your spine if you are a winemaker.

Conclusion: Perception is everything

Several winemakers have proposed theories for why reactions might occur in a wine contaminated by *Brett*. Others have proposed solutions that would take a lot of time to put into effect, if only for the stigma attached to them, for the management of *Brett* in the winery. Among these controversial topics are the proposed use of commercial beverage sterilants and flash pasteurization.

Topics discussed here are meant to further the general knowledge of *Brettanomyces* and as a review of current literature regarding general problems associated with *Brettanomyces* infections in wineries. *Brettanomyces* is still a red-hot issue compared to other problems in viticulture and the economics of running a winery. So where is the funding for research?

Some in the industry have stepped away from the issue entirely and proclaimed a natural symbiotic relationship between good wine and *Brett* that winemakers should embrace.

Some people we have spoken to regarding the "good *Brett*" idea, believe it to be an excuse for producing a faulty wine. After all, if a wine was made under conditions that promoted a specific good *Brettanomyces bruxellensis* strain, any of the other "bad" strains may compete, so where would any sense of control over production be implemented? Perhaps in strain selection and in selective filtering.

One wine buyer told us that he was disappointed in the winemakers and wine writers who promote "Brettiness" in wine. He had believed until now, that the era of making what he called "dirty wine" was over. We have a few more years of very basic research ahead of us before one can completely claim a manageable impact from *Brett*. It seems that the wine industry has selected *Brett* and a few other specific organisms based on their abilities to compete in tiny niches.

But we are scientists, so we would say that. If it were possible to have that sort of microbiological control in a dynamic biological system, I think winemakers would welcome discussion of it. Until then, we think *Brettanomyces* will continue to consume time in debates over research funding. That is why wineries are doing their own basic work in the discoveries of *Brettanomcyes bruxellensis* behavior.

By the way, if anyone has a strain or two that they want to send us, please do so! We are building a database of characteristics and molecular markers, so when someone discovers a specific subtype of *B. bruxellensis* that produces only positive attributes in a red wine, we can have some information about it. The most important thing we have learned in working with *Brett* is to keep consumer perception in mind.

Several years ago, one bottle of red wine was purchased in California specifically to take back to the lab and plate for *Brettanomyces bruxellensis*. The "stink" was strong with this one. One could barely bring it to one's mouth! We had seen similar wines from France that were over five-years-old and produced odors that were much worse, but this was the most "French character" we had ever seen in a wine from California or New York.

I could only afford to buy one bottle ($25), and I could not justify the expense for a case of such a faulty wine to bring back for a wines course, but now I wish I had. The lesson that it teaches is important. The winemaker's tasting notes stated that this was their finest representation of a Bordeaux blend. They heralded its arrival just in time for the Millennium. Recently the winery sold its last bottle for a lot more than $25. Just something to consider when you are staring at the ceiling late at night wondering what *Brett* is doing to your wine.

On the other hand, wines have been received for analyses in our laboratory that exhibited "some" *Bretty* aromas, that were certainly in line with specific regional characteristics and that had been rejected by wine buyers. apparently for their *Bretty* character. The cost of rejection for a wine due to over sensitivity to *Brett* is not only damaging to profit margins for a winery, but its reputation as well. ■

Acknowledgement

The authors wish to thank Drs. Ralph Kunkee and Dr. Paul A. Henschke for their insightful and thoughtful reviews of this work. We also thank Dr. Jonathan Licker for in depth research into the historical aspects of the issues. Finally, we thank Dr. Carl Shively for his comments on this important topic.

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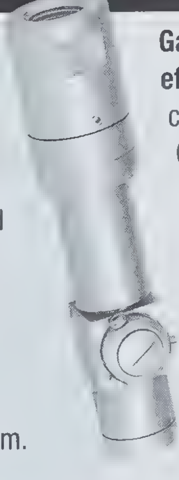

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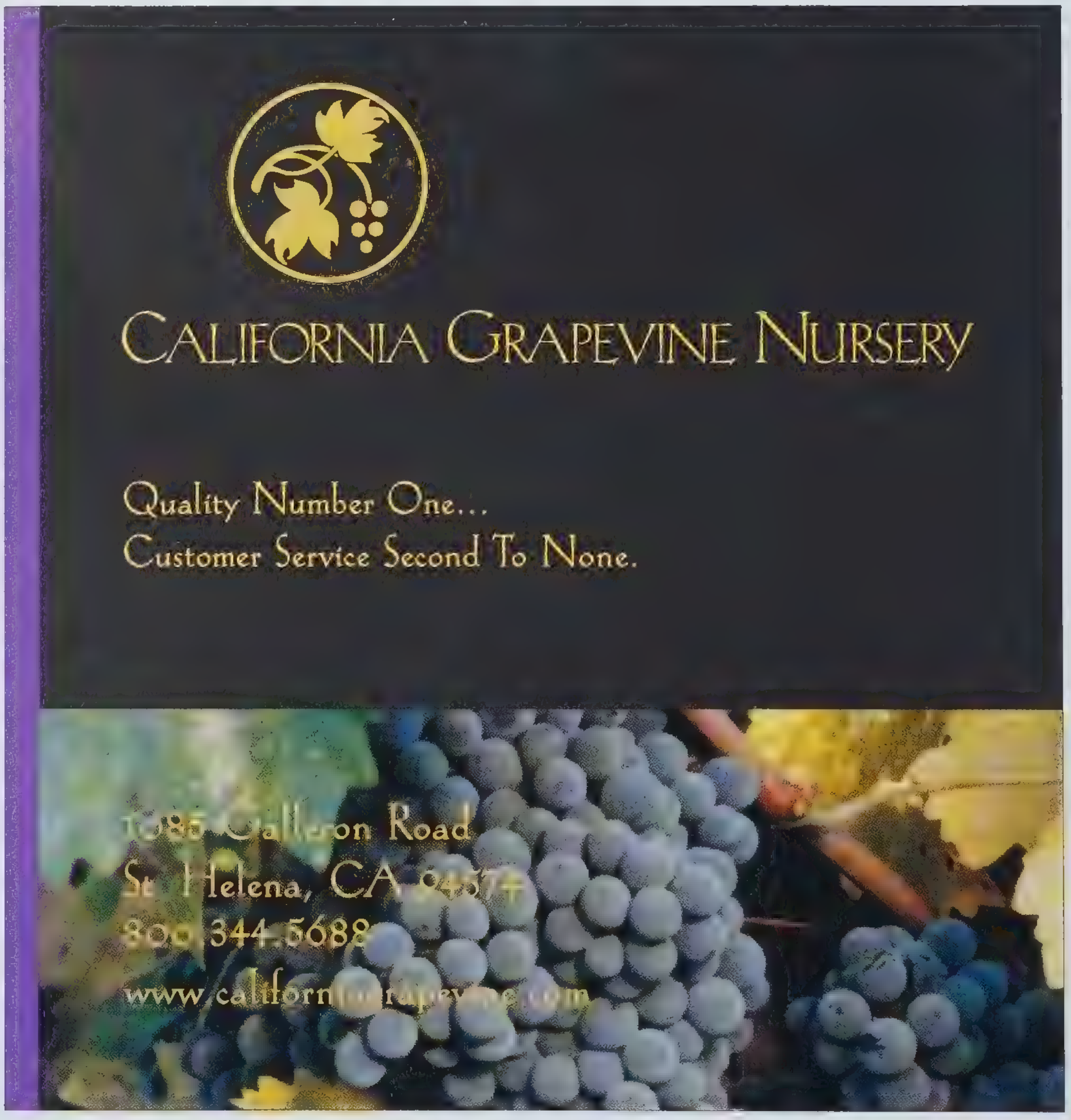
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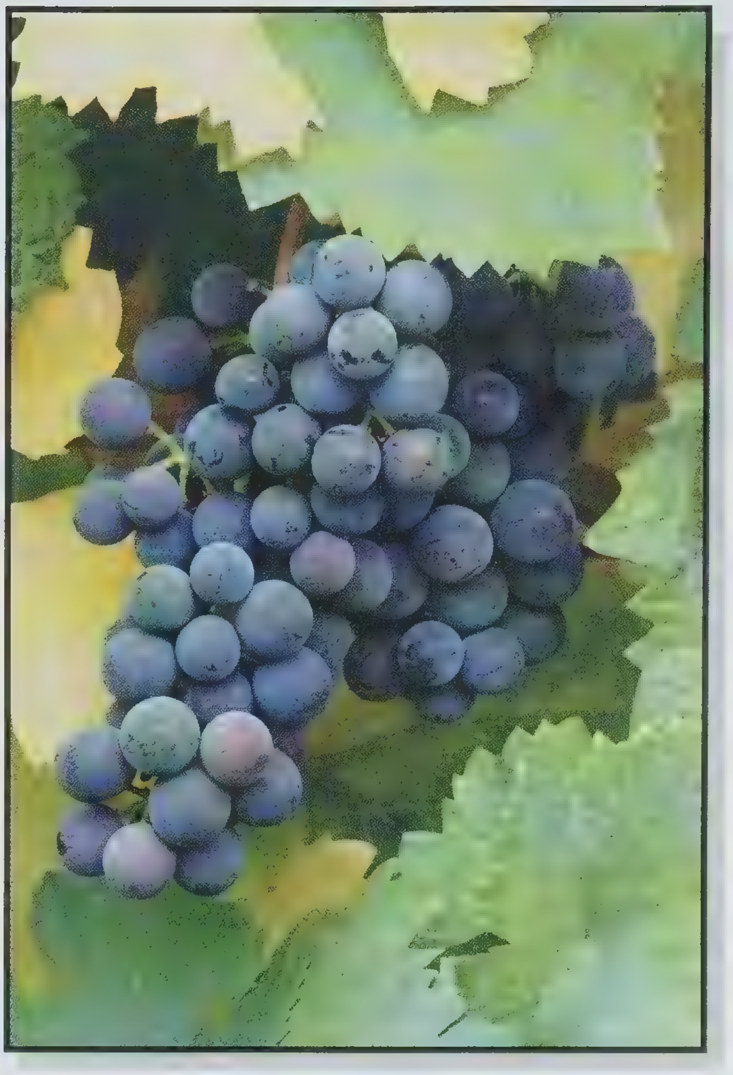

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BRETTANOMYCES

An American phobia

BY Jeff Morgan

Americans hate dirt. They live in an antiseptic society where germ warfare is practiced daily against all the little bugs and bacteria that give the world a large share of its smells. As a nation, we're overwashed, deodorized, and sterilized. Let's face it, we are a paranoid country when it comes to smells and tastes. So is it any wonder that American winemakers are suffering from *Brettanomyces* phobia?

A few years ago, I was having dinner at Chez Panisse (Berkeley, CA) with French winemaker André Ostertag, who had just returned from an American sponsored wine symposium in Hawaii. We ordered a French Rhône off the restaurant wine list. Not surprisingly, it was loaded with *brettanomyces,* kind of sweet in the nose and quite earthy.

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I commented on its microbial pedigree, and André replied, savoring his wine, "What is this 'brett' that you Americans are always talking about? Everyone at the Hawaii symposium was obsessed with it. The real question here is whether or not you like the wine." I did, in fact, and so we dropped the subject.

Nearly everyone reading this article knows about brettanomyces. We refer to it as a *spoilage* yeast, when in fact, it *is* just a yeast — albeit one that can synthesize certain volatile phenols into some pretty potent brew. That's why the British intentionally used the little darling to enhance their beers a century ago. It's no wonder. The Brits have always loved wet leather and saddle soap aromas, just like they're partial to oxidized bubbly and over-the-hill Bordeaux.

Is this bad? Hell, no. The English embrace sensual reality.

Let's go back a few years again, to my days on the *Wine Spectator* tasting panel. We were sampling California Cabernet Sauvignon one day, when one of my colleagues passed me a glass of some broodingly dark, stinky wine. Although I admit that I'm now a confessed admirer of brettanomyces, this sample — even for me — was over the top. I just couldn't handle it. My colleague, however, loved it so much that he nominated it to be "wine of the year" (or some such distinction) and featured it nearly 12 months later at the *Wine Spectator* "Wine Experience" in New York.

By that time, the wine was so ripe that it fairly leapt out of the glass on its own. Did anyone in the audience notice? I suppose so. But did anyone really care? Not a whit. The wine had been dubbed a winner — case closed. Because the audience was predisposed to enjoy the wine, they followed their belief structure. It's only natural. Whenever God is driving, reality takes a back seat.

Today, when I go down to my cellar and pick out an aged French Bordeaux or Rhône for dinner, I often detect some hint of brettanomyces. In small doses, it really can be quite attractive, adding a certain welcome complexity to the wine.

In some of these older wines, though, the imprint of brettanomyces is hardly discreet. But I drink them anyway, giving in to the pungent presence in the name of nostalgia.

Quite frankly, I chuckle at my winemaker friends who agonize over the possibly stinky state of one of their wines 10 or 15 years from now because of a small, but flourishing, brettanomyces population. They should remember that most collectors who hold onto a wine for a decade or more are ready to drink it, no matter what it tastes like. The older the wine, the more flaws are acceptable.

Now don't get me wrong. I'm not suggesting that winemakers adopt the old British technique of inoculating with brettanomyces. Nor do I believe that brettanomyces should simply be ignored. After all, it does alter the essential primary flavors of wine.

But I've watched too many winemakers, mostly American-trained or influenced, bash a very slightly "tainted" wine that is otherwise extremely charming. And that's what I call a phobic reaction to the beast.

Winemakers need to ask themselves, "Am I making wine for technicians or hedonists?" The answer must be the latter, for it's the hedonists who drive prices (and winemaker salaries) into the stratosphere. These sophisticated wine lovers long for strong flavors and aromas, and it's no surprise that the highest rated red wines are said to consistently contain discernable levels of 4-ethylphenol, indicating the presence of brettanomyces.

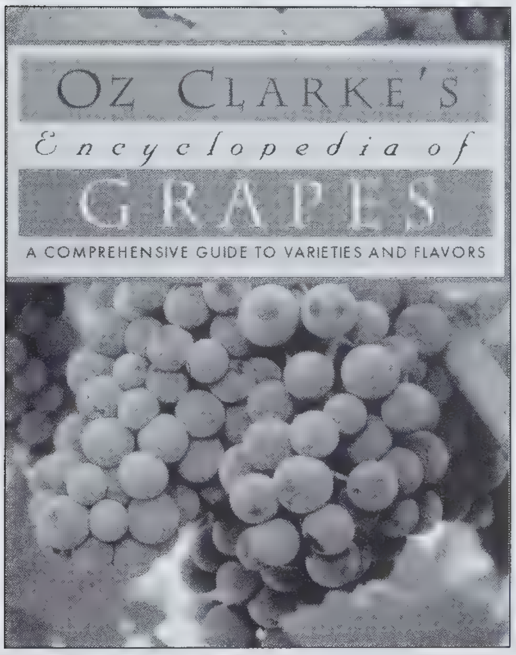
Winemakers should also reflect upon whether the problem lies more with brettanomyces or with themselves. My advice is to analyze a potentially problematic situation and decide whether tools like sterile filtration or sulfur will actually make a significant difference in the bottle. Band-aid aromas may be unacceptable, but smoke and spice are all right. Ultimately, a little brettanomyces in a winemaker's signature may not be such a bad thing. It sure works well for a lot of Frenchmen. ■

Jeff Morgan's new book, "Dean & DeLuca, The Food and Wine Cookbook" *has just been released. He has made both clean and stinky wines in New York and California, has produced SoloRosa, a dry rosé wine.*

OZ CLARKE'S *Encyclopedia* OF GRAPES

BY Tom Hyland

In the introduction to his impressive new work, **Oz Clarke's Encyclopedia of Grapes**, the author offers his rationale for embarking on such a monumental project. For Clarke, there is but one foundation for all aspects of wine enjoyment — the various flavors of wines, their age worthiness, their contrasts due to different growing regions — "We delve into all the things that influence the flavors of our wine, it all comes back to the grape."



And does Clarke ever delve into his subject! One of the world's most well-known and most prolific wine writers, Clarke and his editor/partner Margaret Rand have produced as thoroughly researched a book as has ever been written on wine grapes, from the familiar Merlot and Riesling to the obscure Poulsard and Schiava.

The first section of the book, "All About Grapes," details the history of the vine, and it also gives readers a glimpse into the makeup of a modern vineyard. The author discusses such subjects as grafting, phylloxera, organic farming, and canopy management (well-done illustrations help explain this last topic). While much of the text here is factual material to inform readers, Clarke spins his opinions throughout.

The concept of *terroir* affords a prime example of the author's strongly held convictions. He begins with a huge understatement: "*Terroir* is a relatively poorly understood concept." He goes on to offer his definition of *terroir* as "the sum of all of the parts of the vineyard, including geology, climate and sun it receives," and finishes with a typically amusing take on the subject. "The more blinkered members of the wine trade can still sometimes be heard extolling bottles that are badly made and reek of sulphites as exhibiting *terroir*."

The second part of the book is the A–Z encyclopedic review of the world's wine grapes. Clarke has designated 17 grapes as classic, from obvious choices, such as Cabernet Sauvignon and Chardonnay, to some under-appreciated varieties, such as Chenin Blanc, Semillon, and Tempranillo. These grapes are given an entire chapter each as the author explores where the grapes are planted, clonal differences, soils that are best for planting, yields, and many other topics.

These chapters run 12 pages, offering descriptions of each grape the world over. For Clarke, Oregon Pinot Noirs are all about "charm and suppleness," while Chile has managed to capture Pinot Noir's silky texture surprisingly well. He also notes that while the growers of the Loire have recently stepped up their efforts with Sauvignon Blanc because of its success among New Zealand producers, it is "not a style they admire."

Other grapes receive two-page treatments, including Pinot Blanc, Pinot Gris, Malbec, and Roussanne. Clarke is up to date here, detailing the recent confusion in California over vines that were actually Viognier but mistakenly identified as Roussanne. Here, as with the classic grape sections, there are lists of the author's choices for best producers and recommended wines.

Other grapes get a paragraph or two of text, and are there ever some obscure grapes listed here! After a brief look at Gruner Veltliner, there are short commentaries on the following grapes (in order): Gutedel; Hanepoot; Harriague; Harslevelü; Heida; Hondarrabi Beltza; Hondarrabi Zuri; Humagne Blanche; Humagne Rouge and Huxelrebe. All of this on one page!

Much research has been conducted on grape DNA in recent years, so a new reference book on grapes was overdue. **Oz Clarke's Encyclopedia of Grapes** is a great undertaking on this subject.

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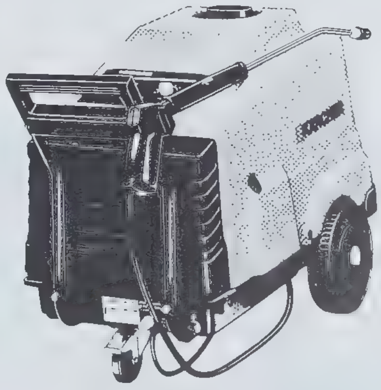

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Electrical safety in the winery

How to save life, limb, and expense in your power distribution system

BY Ken Arthur,
Arthur Engineering

Electricity is the one utility that is capable not only of bringing your production to an immediate halt upon its failure, but worse still, it can wreak great havoc upon your personnel and property. That is why it never ceases to amaze me how little concern is given to electrical safety in the winery.

One reason for the not-always-benign neglect of electricity is perhaps because it is, for the most part, invisible. Unlike a break in a water line, refrigerant line or even a hydraulic line, the break or open exposure in an electrical circuit lies dormant until something or someone completes its circuit, usually to ground.

Often ignored is the fact that those generally, least qualified to be in contact with an industrial strength electrical power distribution system are those whose daily tasks require this contact. Plugging and un-plugging portable pumps, using pushbutton controls, handling portable lights and portable tools, clearing jams or removing foreign objects from screw conveyors after just turning off the motor's controller — these and many more such dangerous jobs are usually the purview of the cellar worker or seasonal worker in large wineries. In smaller wineries, these jobs often fall to the owners or close family members.

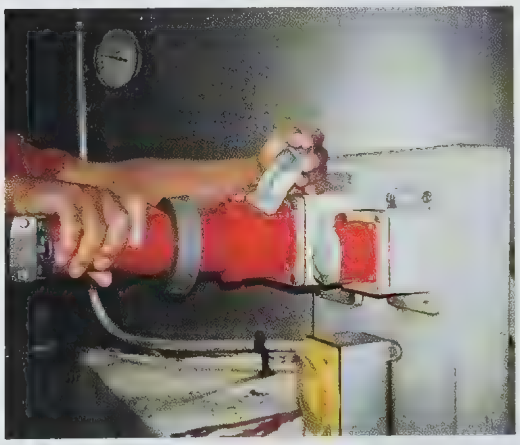

Figure I – Since this receptacle provides a means to disconnect a portable pump from its source of electrical power, it is by definition a "disconnecting device." The National Electrical Code states that any such device in a motor circuit must be "horsepower rated." This pin-and-sleeve device is not.

Electricity's destructive power

Our company once designed a new electrical power distribution system for a small winery that had the potential for becoming a major producer in the near future. The owner rejected a 480-volt three-phase power distribution system design because he was afraid to have his winemaker/son exposed to such high voltage.

It seems the son often liked to try to "fix" electrical problems that occurred in the winery, so the father did not want him exposed to a system with more than 120 volts to ground. Statistically, however, more people are killed or injured at 120 volts than at any other voltage — probably because they have dealt with that voltage in their homes all of their lives and they tend not to be afraid of it.

Being afraid of electricity is a good thing. Its care and keeping — regardless of the voltage level — should *always* be left to those with the required skills and training. Remember: it's the current (not the voltage) that kills you.

In fact, even those with skills and experience are not immune to being injured or killed from a momentary lapse in caution. Usually they're in a hurry, perhaps under pressure to fix a system that is down in the middle of harvest, while there are truckloads of grapes lined up in the hot sun.

I recall one skilled electrician with many years of experience who was killed when working on an electrical panel with a cover that lifted up (like most home-type electrical service panels) and secured in the up position with some type of latch or hook. Unfortunately, the latching mechanism was missing on this panel and since he was under pressure to solve the problem, he rested the panel cover on top of his head rather than take the time to rig something to hold the cover up. Probably among his last thoughts were, "This will only take a sec."

He somehow got in contact with a live part somewhere in the panel and the cover provided a perfect, low-resistance

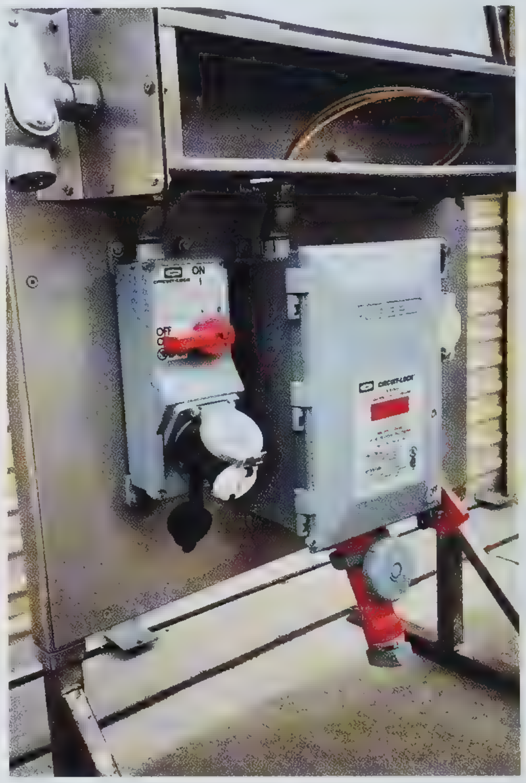

Figure II – This "sample"was constructed to demonstrate several safety issues when grouping portable pump outlets. Two versions of interlocked receptacles are shown: pin-and-sleeve (right) and a form of Twistlock (left). To drain water that gets into all winery conduit systems, the overhead conduit enters the side of the wireway above the switches and the bottom of the TEE is left open.

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path to ground right through his heart and brain. He might have survived that mistake by not being so well grounded, or at least grounded through a much higher impedance (his shoes for example) than he got from resting the cover on his head.

Managing "available short circuit current"

It's important to remember that your electrical system is capable of delivering large amounts of current.

A short circuit, or the unintentional connection of two or more phases of your electrical system, looks like you have turned on a big load, so the utility sends in a large volume of current to satisfy that load.

Let's use an analogy here: If you open the racking valve on the bottom of a 30-foot diameter, 35-foot high tank filled with grape juice, the pressure and volume of juice flowing out of that valve is significantly greater than when there are only a couple of feet of juice above the valve.

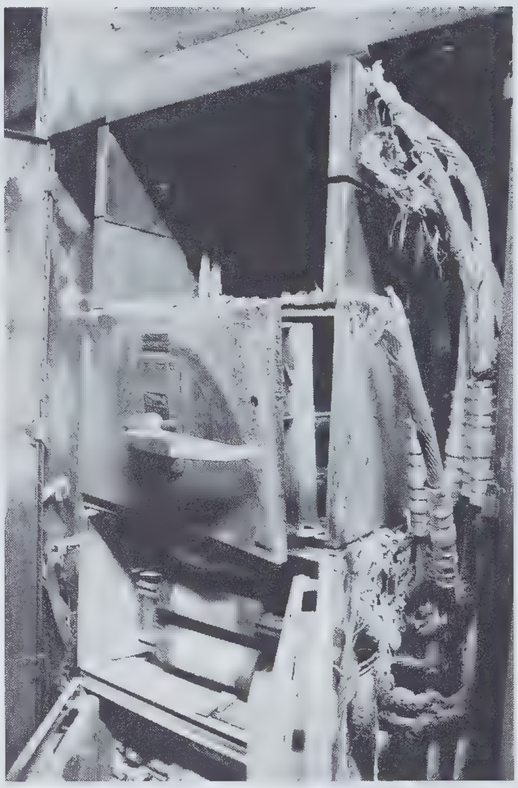

Figure III – This power switchboard burn-down probably started as an arching ground fault and escalated to a phase-to-phase fault before the main circuit protective device opened. It is testimony to the destructive force of "available short circuit current" that can be supplied by your serving utility, and why the National Electrical Code says that your electrical system must be capable of handling it.

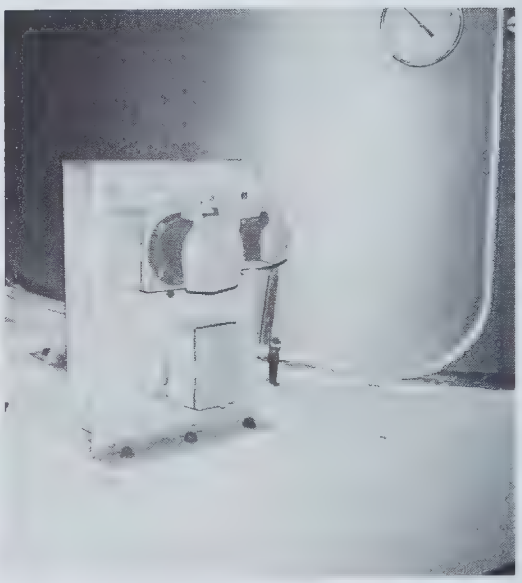

Figure IV – A typical portable pump outlet station found in old and even new winery construction. Note the absence of a horsepower-rated disconnecting device ahead of the outlets.

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In an industrial facility, the electric service is larger, the feeders are larger, the distribution panels are capable of carrying larger currents, and the branch circuits are larger than those in your home. As a result, the electric utility company, which you could look at as an infinitely large tank, can, for better and worse, deliver lots of juice through your electrical system.

It's called the "available short circuit current," and its magnitude is dependent upon the size of the electrical power distribution system from the utility's source generator right down to your portable pump outlet. Since your electrical power distribution system pipeline tends to get smaller the closer it gets to each individual load or outlet, the total short circuit current available at your service switchboard is reduced throughout the system.

Another good analogy is to visualize your electrical power distribution system like the sprinkler system in your lawn — the farther you get away from the water source, the lower the pressure. The National Electrical Code, however, requires that every component in your electrical power distribution system be capable of withstanding and/or interrupting the level of short circuit current that is available at its (the component's) particular connection point in the system.

Using our sprinkler system analogy, this is similar to calculating the pressure at each sprinkler head and connection point in the system, and then choosing components that will withstand those various pressures. In a sprinkler system however, the pressure is limited by a pressure regulator somewhere in the supply system, so you can select all of the components to exceed that maximum pressure. The costs would be prohibitive to do that in your electrical distribution system.

Short circuit currents in the magnitude of 50,000 to 60,000 amps at 480 volts, three-phase, are possible at the service switchboards in some larger wineries. As stated above, electrical equipment chosen for components of your electrical distribution and utilization system, by code, must be capable of handling and interrupting these large volume currents (the "available short circuit current").

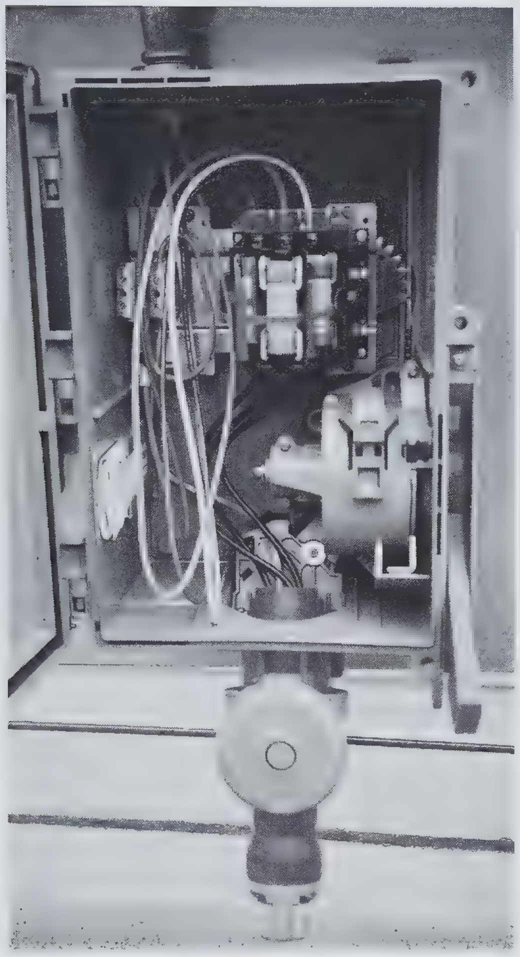

Figure V — This demonstrates the correct way to terminate the incoming power circuit. Note that the incoming conductors form a "drip loop" before their termination at the top of the fuses. This allows any condensate or casual water that enters the switch enclosure by "wicking" down the conductors to drip off into the bottom of the enclosure rather than onto the energized terminals at the top of the fuses.

Choose the right circuit breaker

How does available short circuit current relate to safety in your winery? It represents the greatest hazard to your property and personnel if the components of your electrical power distribution system have not been properly selected and applied.

Circuit breakers have three application ratings: a voltage rating, a current rating, and an interrupting rating. Proper circuit breaker selection requires applications that meet, or are within, all three ratings. For example, let's consider a circuit breaker with the following ratings:

1. Voltage Rating – 277/480V
2. Current Rating – 20 amps
3. Short circuit "amp interrupting rating" (AIR) – 14,000 amps symmetrical at 480 volts

The proper application of this circuit breaker would require:

1. That the circuit voltage would not exceed 277 volts to ground and 480 volts phase to phase
2. That the circuit load would not exceed 20 amps continuously at 480 volts, three phase
3. That the available short circuit current does not exceed 14,000 amps at the point of installation.

I cannot tell you how often, in more than 30 years associated with the wine industry, I have looked at a switchboard or electrical panel and found circuit breaker(s) that were installed at some point after the initial installation that have a significantly lower interrupting rating than the original breakers.

For example, it is not unusual to find a circuit breaker with a 14,000 amp interrupting rating (AIR) has been added to a panel where all of the original circuit breakers have a 65,000 AIR. Chances are good that the original designer would not have specified the more expensive 65,000 amp breakers if ones with a lower and less expensive AIR would have been sufficient.

If the short circuit calculation determines that the "available short circuit current" at this panel could be as high as 50,000 amps, installing a circuit breaker that has only a 14,000 AIR puts both personnel and property at risk if the device is used to "interrupt" 50,000 amps.

To help avoid the problem associated with improper installation of underrated circuit breakers after the initial installation, our specifications require that the panel manufacturer install a sign within the panel advising that "Only circuit breakers with minimum XXXXX short circuit interrupting ratings are to be installed in this panel."

Beware amateur installation

What should you do? Don't let anyone but a well-trained electrician or electrical contractor install electrical devices in your winery. If in doubt about the adequacy of any equipment being installed or that you plan to install, consult with a professional engineer who can run a short circuit analysis of your system to determine the necessary equipment ratings. Figure III shows what can happen when improperly applied electrical equipment fails.

One of the areas in the winery where we find the greatest hazards (and most incorrect installations) is electrical outlets. Think about it — this is the one location in a winery where the least skilled worker comes in direct contact with the electrical distribution system. It needs to be as fool-proof as you can make it. Figures I and IV show what we often find — even in recently constructed facilities. This is a code violation that very often even building inspection officials miss.

The National Electrical Code requires that every disconnect device in a motor circuit be horsepower-rated. This is because an electric motor is an "inductive" device. It requires magnetizing current to function, and without getting technical, when you try to break its supply cir-

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cuit, it arcs across the contact points of the disconnect device until the points are far enough apart to extinguish the arc. This arc releases lots of energy, and if the contact points are not (horsepower) rated to withstand the energy of the arc, they can fail — often violently.

Pin-and-sleeve plugs and receptacles like those shown in Figures I and IV, are current-rated — not horsepower-rated. For example, they may have a rating such as 30 amps at 480 volts. That means they are rated to continuously carry 30 amps at that voltage. When examining your 10-horsepower pump motor and its nameplate, you will find the full load current at 480 volts, three-phase, is somewhere around 14 amps.

No problem for a plug and receptacle rated 30 amps, you say. You are correct — except when you try to disconnect the motor from its supply by pulling apart this plug and receptacle while the motor is running. Then, the "circuit breaking" current momentarily flowing through this device, can be six to10 times greater than its running current. Since the pins and sleeves of this connector are not rated to carry this level of current, they can sometimes fail — literally right in your hands.

But, you say, "I always turn off the pump at the starter on the pump cart before I unplug it,"— or you instruct your cellar workers to do it that way. In most tank alleys however, the portable pump outlets are clustered together in groups between tanks, with groups repeated on some spacing within the typical cord lengths on your portable pumps.

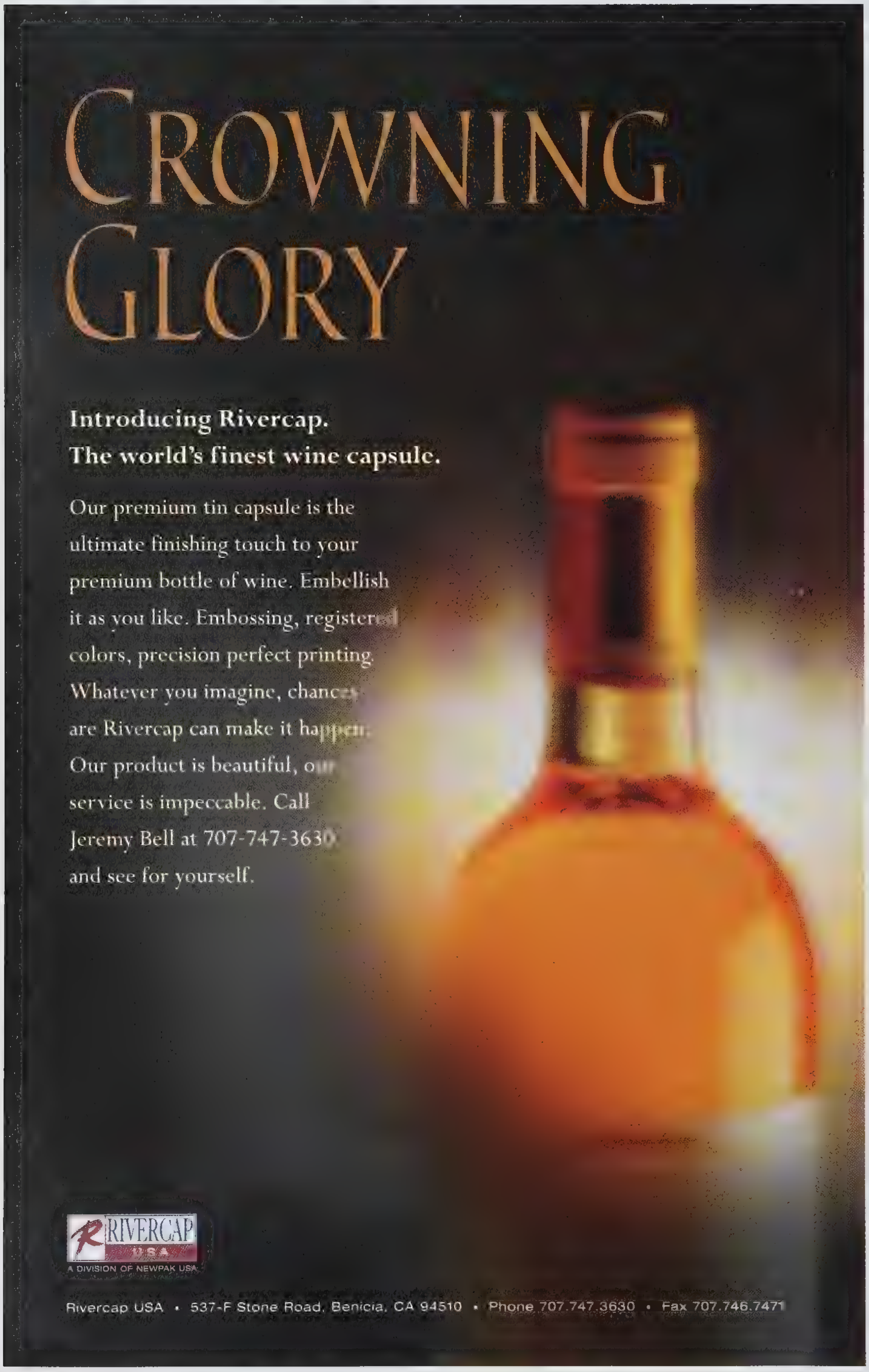
It is easy to imagine that in an active tank alley where there are several pumps operating at the same time with cords and hoses intertwined on the alley floor, that you or a cellar worker could turn off the pump at the cart and mistakenly unplug the cord of another operating pump.

Some will contend that the plug on the end of a portable pump cord is not a "disconnecting device" and therefore not required by code to be a "horsepower-rated" device. Common sense says that if it can be used as a disconnect device it should be called one and therefore rated as one.

Foolproof interlocked switch pin-and-sleeve receptacles

Fortunately there are now several manufacturers who can provide pin-and-sleeve receptacles that are mechanically interlocked to a horsepower-rated disconnect switch in a common enclosure. This makes as foolproof a connection point as you can get for your cellar and other locations within the winery (see Figure II and V). The plug cannot be inserted

Continued on page 71



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MYSTERY SOLVED!

Zinfandel’s origins discovered

BY Rhoda Stewart

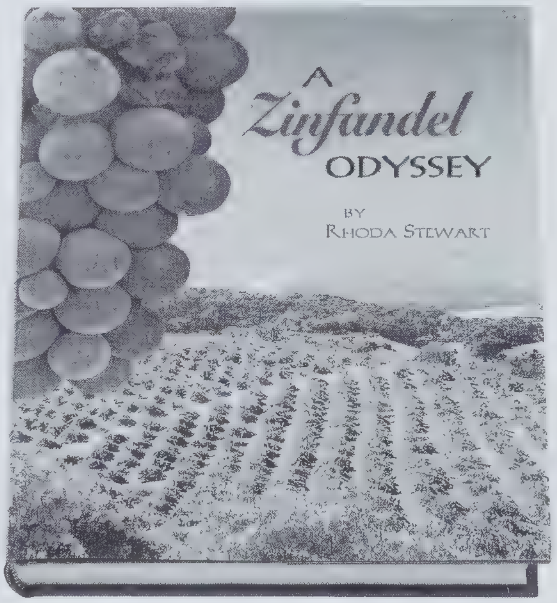
When I met UC Davis plant geneticist Dr. Carole Meredith one November afternoon in 1997, she knew only one thing for sure about Zinfandel’s European connection: “California’s Zinfandel and Italy’s Primitivo *are* proven to be genetically indistinguishable. Dr. Austin Goheen made that connection at UC Davis in the late 1960s. We’ve since shown by DNA analysis that Zinfandel and Primitivo are the same variety.

“But Primitivo has not been in Italy for very long,” she added, “probably no more than 200 or 300 years. ”

Meredith also noted that the official Italian ampelography says that Primitivo is not an indigenous variety to Italy, but that it came from somewhere else. “That suggests that both California and Italy got the grape from a third place,” she said. “The question is ‘from where?’”

Looking at a map of the area of Italy where Primitivo is grown, Meredith pointed it out in Puglia, in the heel of the country. It is directly across the narrow Adriatic Sea from Croatia, so it is quite logical, she continued, that a grape introduced into Puglia might have come from Croatia.

While the inland part of Croatia has a harsh continental climate, the Dalmatian Coast is typically Mediterranean in climate and culture. Fresh fish, mussels, olives, and plenty of red wine are the staples of the Dalmatian diet. “The best wines along the Dalmatian Coast are made from a grape called Plavaç Mali,” noted Meredith, “which looks suspiciously similar to Zinfandel.



“The idea that Plavaç Mali might somehow be connected to Zinfandel has been around for a long time. It’s just that there has been no real way to test that idea until recently. We have had some Plavaç Mali in our National Grape Germplasm Repository at Davis since 1977. Grown side by side with Zinfandel, it looked similar, but not identical in the way Primitivo and Zinfandel did when they were first grown side by side.”

In May 1998, Meredith went to Croatia to take a closer look at Plavaç Mali and to collect samples to bring back to Davis for DNA comparisons with Zinfandel. The trip came together beautifully for her.

First, Mike Grgich (born in Croatia, president and winemaker of Grgich Hills Wine Cellars, Rutherford, CA) offered to help by providing accommodations and some contacts. Then, Ivan Pejic, a Croatian researcher from the University of Zagreb, coincidentally contacted her to ask for assistance in launching a research project aimed at learning more about old Croatian grape varieties.

Jasenka Piljac, a young Croatian woman working part-time in Dr. Meredith’s UC Davis research lab as an undergraduate biochemistry student, was returning to Zagreb and would be available as Meredith’s assistant, guide, and translator. Piljac’s family’s roots are on the Dalmatian Coast, so the project was dear to her heart.

Meredith arrived in Croatia in May 1998. Accompanied by Pejic, his colleague Edi Maletic, Piljac, and some local experts, she went to Plavaç Mali vineyards along the coast and on some of the larger coastal islands. A few weeks later, she returned to Davis with 150 samples to analyze.

By fall of 1998, with the DNA results in, it was obvious to Dr. Meredith that Plavaç Mali was definitely **not** Zinfandel. But it wasn’t completely unrelated either. What became apparent was that Plavaç Mali and Zinfandel shared considerable family history, so much so that Plavaç Mali could have been one of the parents of Zinfandel — or vice versa.

“We concluded from these results that most Plavaç Mali is of a single type, which is not the same as Zinfandel, although it seemed closely related to Zinfandel. But that study didn’t tell us that Zinfandel did not originate in Croatia, only that it is not the same as Plavaç Mali, so we kept looking.”

Research continues

Each year since then, Ivan Pejic and Edi Maletic continued to poke around in old vineyards of the Dalmatian Coast, especially the more remote ones on the coastal islands. They were not only looking for Zinfandel, but also for other interesting old varieties threatened with extinction so that they could

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This article is an excerpt from an interview with Dr. Carole Meredith at UC Davis on the origin of Zinfandel from my book, A Zinfandel Odyssey, *published by* PWV *Inc. San Rafael, CA © 2002 and includes new information available since printing of the book.*

preserve them as part of Croatia's viticultural heritage.

"They gathered samples of everything that looked interesting that they hadn't seen before and sent them to us in Davis," Meredith added. "We analyzed the DNA in the lab and reported back to them. Many of the varieties were obviously relatives of Zinfandel, reinforcing our idea that Zinfandel was a Croatian grape, even if we couldn't find it there today.

"In fall 2000, Ivan and Edi collected more samples and sent them to us for analysis. One of them proved to be particularly interesting. It's a variety called Dobricic, a very old variety grown almost exclusively on the island of Solta. By June 2001, we had discovered that, just like Zinfandel, Dobricic is closely related to Plavaç Mali. In fact, Zinfandel and Dobricic appear to be the parents of Plavaç Mali. This further strengthened the case for a Croatian origin for Zinfandel and, furthermore, it meant that Zinfandel was even older than Plavaç Mali, itself thought to be a very old grape."

In fall 2001, said Meredith, Ivan and Edi made another expedition before their funding ran out. "They wanted to go back to a few vineyards to try to reconcile some ambiguous results we had obtained the year before. By now, Ivan was equipped to do some DNA analysis in his own laboratory in Zagreb.

"In early December, Ivan sent me an email that was full of exclamation points! His preliminary DNA results from one of the latest samples, a grape called Crljenak, showed that it matched Zinfandel! We had analyzed samples of Crljenak before, but Edi and Ivan said that this one is different from the others."

Crljenak (pronounced Tsurl-ye-nak) grows among other varieties in a vineyard just outside the coastal town of Split on Kastela Bay. Not a highly regarded or extensively planted grape, its full name is Crljenak Kasteljanski. Roughly translated, it means "the red grape of Kastela."

Edi and Ivan sent a sample of this vine to Meredith so that she could do a more extensive DNA analysis in her lab. When she finished the work, she could say with confidence — Crljenak Kasteljanski *is* the same variety as Zinfandel! ■

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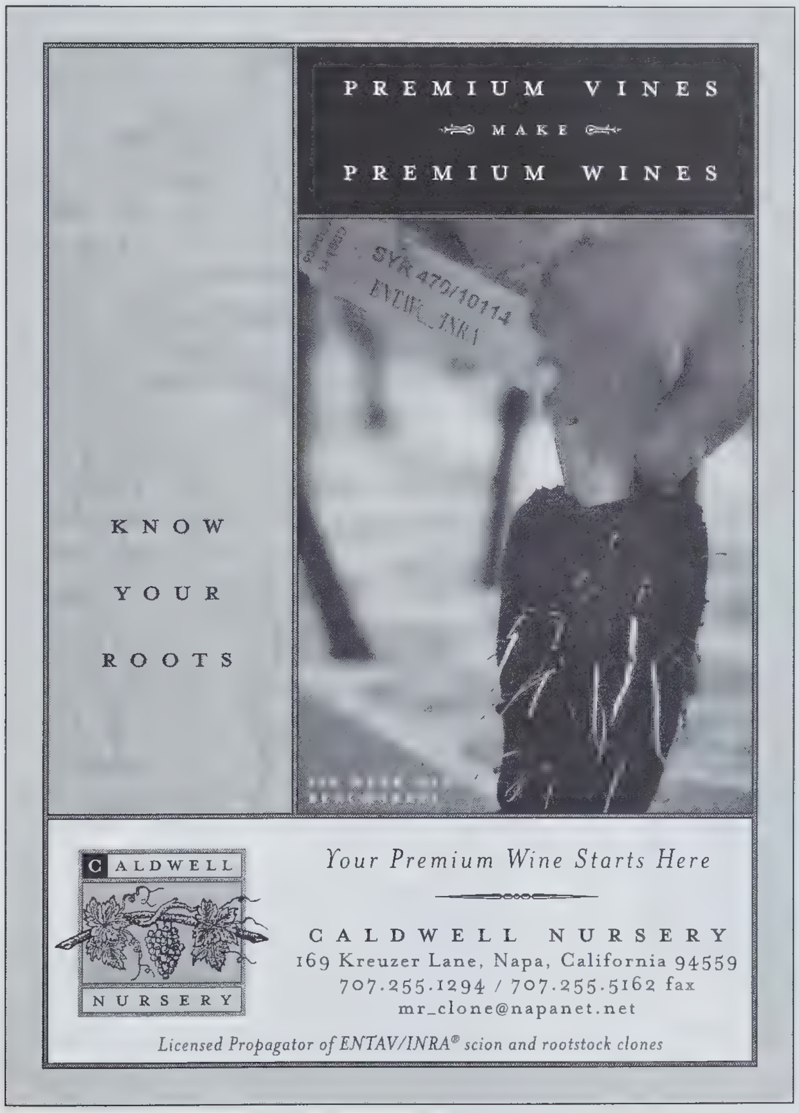

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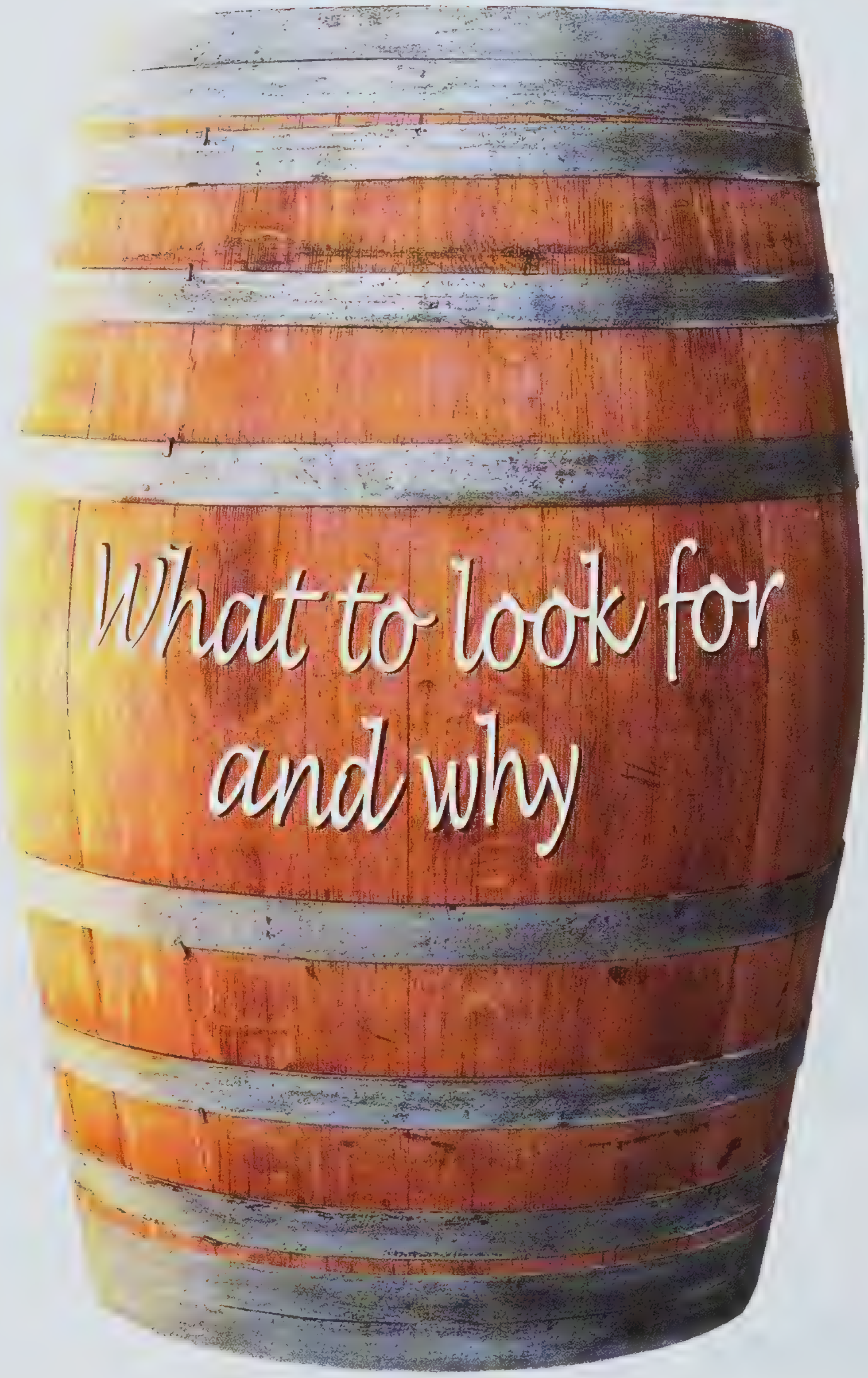

What to look for and why

BY Henry Work

When you bought your first car, you drove it home, parked it in the driveway, and gave it a good once-over, even though you had inspected it several times before your purchase. After all, you wanted to know that you'd spent your money wisely because this new vehicle was going to be an important part of your life. Think of your barrels the same way — you pay good money, and they play a critical role in your winemaking life.

Since it is a product so important to your wines, you should inspect the inside of *every* new and used barrel you purchase. Even though the cooperage industry has made huge improvements in quality control and the general quality of barrels has probably never been higher, there are many things that can go wrong between the cooperage floor and your cellar.

Using a good barrel light inserted into the bung hole, you can check for mold and debris, while at the same time, your nose can detect any off-aromas. At several hundred dollars for each barrel and hundreds of dollars for the wine that is put into it, the labor cost of a visual and olfactory inspection to detect barrel problems is infinitesimal compared to the risk of damaged or spoiled wine.

In addition to these initial inspections, you should undertake a comprehensive physical inspection of at least 20% of the barrels you receive. Procedures of this inspection are described below.

Should you encounter any of the problems listed, contact your cooperage salesperson, distributor, or the cooperage to alert them of the situation and discuss the remedies. The feedback you provide to the cooperage greatly assists them in crafting their barrels to your needs and specifications.

Inspection ABCs

For the physical inspection, you will need a good barrel light, non-probe moisture meter, tape measure, a set of the cooperage manufacturer's specifications, and the full attention of your eyes and nose. Begin by randomly selecting at least 20% of the barrel lot — 5% from the beginning, 10% from the middle, and 5% from the end. Mark each of them with a sample number and keep the inspection data for future reference in case of problems. Major problems in any of the areas below may require inspection of additional barrels.

This total inspection should begin with a visual examination of the barrel exterior, including the wrapping, as it may give a clue to hidden damage. Look for broken chimes, heads dented or displaced from the croze, and misaligned staves. Also look for scrapes and gouges, and especially any torn or burred hoops, which can wreak havoc on the cellar people's hands.

Using a non-probe moisture meter (available from Tramex or Warner Electronics, among others), check to see that the wood moisture is within an acceptable range (European oaks usually contain 15% moisture +/– 2%; American oaks are usually 13%, +/– 2%). Too much moisture may indicate incomplete drying, resulting in a green or woody taste, and/or wood shrinkage that leads to leakage. Too little moisture can result in excessive swelling, causing the hoops to break or heads to warp.

Signs of dryness on the outside of the barrel (loose hoops, gaps between staves or headboards, and looseness in the heads) could be the result of a long, hot container ride or storage too long in a warehouse. Neither is a cause for concern, but requires a little more time and water soaking up prior to use.

Because of the excellent quality of today's cooperage, you will rarely see the following problems, but even with the best quality control, something slips by occasionally. You need to be aware of these problems and why they are of concern.

Preventing leakage

Hairline cracks in the bilge of the staves are generally not a problem, but if they are numerous it could indicate insufficient heating of the barrel. Large cracks can be caused the same way, or from the barrel being dropped; both are a cause for concern because of the potential for leakage.

A few plugs (wedges or spiles) in the wood are normal; but several in one spot or throughout a stave or head board indicate attempts at repairing porosity or insect damage. They suggest a piece of wood with the potential for leakage. Small, tight knots, no larger than 0.5 cm in diameter, are acceptable.

Divots (hollows or gouges in the wood created during the splitting and milling processes) on either the staves or head boards are acceptable within the following parameters: they should be no deeper than one-third the wood thickness; around the chime they should not be deep enough to impact

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the seal of the head at the croze; and they should follow the grain pattern to indicate that they are a natural result of splitting the wood, as opposed to cut or split divots caused by dull blades when machining the wood. In excess, these last types of divots may indicate poor jointing, leading to leakage. There should also be no sapwood in the joints, as it will eventually leak.

Tale of the tape

Carefully inspect the metal hoops; watch for tears or burrs as noted above. Look also for stretched or sheared rivets, which indicate that the hoops have been put on too tight and may burst if the barrel expands. Using the manufacturer's specifications, measure the hoop placement. Hoops more than 1 cm off, different from barrel end to barrel end, or different from barrel to barrel could indicate variation in capacities, with the potential to frustrate stacking and or racking from barrel to barrel.

Cooperage problems have you over a barrel?

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While your tape measure is out, measure the barrel dimensions and compare to the manufacturer's specs — all dimensions should be within 2%. In addition to problems caused by different capacities, large discrepancies in the length or bilge diameter could also indicate barrels made at different times or at different locations — which could be a problem if variations in capacity become an issue.

The bung hole is of prime importance, since it is the gateway not only for your wine, but for microorganisms as well. The bung hole should arrive covered, either by a bung, whether the flat wooden shipping type or silicone which should be intact, or by plastic wrapping. Plastic wrap around the barrel will seal the bung hole during shipping. The hole should be the size you have specified, not what the cooperage wants to give you. It should be centered on the bung stave, round, and evenly and thoroughly cauterized to seal the bung well and prevent wicking around the bung.

The bung stave should be wide enough to support a hole without cracking, usually 10 cm (four inches) or more. Look carefully in the hole to the inside of the stave; there should be no great cavities or cracks to capture and hold wine. Since this is a prime evaporation area, it is a location extremely susceptible to spoilage.

Going inside

You are now ready to inspect the inside of the barrel. Be cautious of excess sulfur exposure as you place your face near the bung hole. Take small, shallow breaths through your nose as you slowly edge closer. If you do find a strong smell of sulfur, allow the barrel to air out before proceeding. Barrels made a month or two prior to delivery at the winery should have little sulfur smell. A large dose of sulfur could indicate an attempt to hide a problem, so air the barrel out and look closely.

Cooperages generally use sulfur as a precaution against mold growth when water has been used while testing barrels for leaks. Barrels shipped over the ocean are most susceptible to mold problems due to condensation within the shipping container. While most cooperages are shipping barrels that have been sulfur gassed, some may still use wicks, or used barrels, shipped from some wineries, may have been wicked. If wicks have been used, look for sulfur drips which could cause hydrogen sulfide upon introduction of a wine.

The point of this inspection is to look for mold and to smell for off-odors due to mold or other bacterial spoilage, but you are also checking to see that the barrel is clean and free of sawdust, strips of flagging hanging into the barrel, wood chips, and trash. I experienced the latter once, I am ashamed to say, when a customer returned a small piece of sandpaper, that had been found in the barrel.

The inside of the barrel should be dry. Look for mold, particularly near the croze where the heads meet the staves. This is the most likely spot to contain some standing water from the testing process, or from the flour paste that is used in the croze, which is an excellent medium for mold if the area was too moist.

The barrel aroma should be clean, fresh, oaky, and/or toasty. Other than sulfur, there should be no chemical odors. Be aware of possible smells from such things as preservatives or paints, which can be introduced during transit in a shipping container, especially if a bung is missing.

A new or newly refurbished shipping container may have a high residual paint aroma or vapors from the preservative applied to the floorboards. There is some evidence that links these preservatives to trichloranisol (TCA) taint in the wood of the barrel. Should any of these aromas be detected, contact the cooperage, as well as a wine laboratory, to check for TCA or other contamination.

The toast color should be within your specifications, and should be fairly uniform throughout the body of the barrel, and from barrel to barrel. The ends of the staves normally have little toast color, especially in light or medium toasted barrels. It is also normal to have some variation stave to stave. Color that is "too uniform" indicates some manipulation with the toasting fire, such as a cover being used which can produce an undesirable smoky taste.

Unfortunately, color is only an approximate indicator of time on the fire, but a rich, uniform, non-smoky color without excess blisters is normally the only indicator a winemaker has of sufficient time on the bending and toasting fires. If toasted heads have been requested, they should also be of uniform color and of equal shade on both heads.

There is much debate over blisters, especially regarding whether they have a tendency to induce wine spoilage. Some winemakers believe that blisters become a collection point for wine, which can then spoil when the barrel is empty. But others assume that given the porosity of the wood and in combination with good cleaning procedures, blisters pose no more potential for spoilage than do any other nooks and crannies of a barrel.

Regardless of the correct answers to that continuing debate, while some blisters are normal, excessive blistering or very large blisters (2 to 3 cm deep and 4 to 5 cm long) indicate rapid heating of the wood, or the use of oak with an excessive moisture level. Both of these are signs of shortcuts taken during the coopering process, and are cause for real concern for the eventual taste of the wine.

Summary

The three most serious problems for new barrels are: 1) indicators that the barrel will leak, 2) mold or off-aromas inside the barrel, and 3) too much or too little toast on the inside. In the first case, ask the cooperage to repair the barrel; in the second and third cases, reject it. ■

For the past 10 years, Henry Work has been general manager of Canton Cooperage in Kentucky. He and his staff have transformed Canton from a bourbon barrel producer to a premium American oak wine barrel cooperage. Before working at Canton, Work was a partner in Barrel Builders in Napa Valley. There he learned the art of coopering without hitting his thumb too many times.

Electrical Safety

Continued from page 64

into the receptacle nor withdrawn from the receptacle unless the disconnect switch is in the "open" or "off" position.

Using the scenario above as an example — where the wrong plug is pulled in a busy tank alley — now it doesn't matter because a horsepower-rated switch has interrupted the still operating pump motor. If your winery is using anything other than interlocked receptacles for your portable pumps, your operation is not as safe as it could be.

Summary

These safety issues are only two of many with which you as the winery owner/manager need to be concerned. An electrical power distribution system properly designed and installed provides not only a safe working environment for your employees (or family), but also reliability.

There is nothing that is harder and more wearing on a winery's electrical distribution system than full use at close-to-capacity for two or three months, then light loads the rest of the year.

In discussions with my clients, I have always found myself repeating the cliché — which was probably first uttered even before Thomas Edison — that doing it right the first time is much less expensive than returning to fix it later. ■

Ken Arthur is the President of Arthur Engineering, Inc. His company has provided elecrical and control system engineering and design expertise to wineries for over 30 years.

CALENDAR

Eco-Farm's Sustainable Wine Grape Conference

June 6, 2002, Madera Fairgrounds, Madera, CA

Growers, researchers, crop advisors, and industry-related businesses will share information on the latest sustainable agriculture practices, highlighting advances in sustainable winegrape growing, using cover crops to reduce pesticides, sustainable weed management, pest monitoring and IPM, farmscaping, and more.

Speakers include: Karen Ross, president of CAWG; Jenny Broome, Sustainable Ag Research & Education Program (SAREP); Jon Holmquist, Canandaigua Winery; Kent Daane, UC Cooperative Extension; Jeff Dlott, Real Tool Box; Kurt Humbree, UC Cooperative Extension; Lauren Freeman, Freeman Farms; and Herb Quady, Quady Vineyard.

Pre-registration is $30 and includes a catered organic lunch. For more information or to register, contact: Sarah Potenza, tel: 831/763-2111, e-mail: info@ecofarm.org, or visit www.ecofarm.org.

4th Joint Burgundy Winemaking Symposium "Optimizing Pinot Noir Typicité & Quality"

June 25, 2002, Oregon Convention Center, Portland, OR

The fourth joint Burgundy Winemaking Symposium, "Optimizing Pinot Noir Typicité and Quality," will be held in Portland, OR on Tuesday, June 25, 2002 in the Oregon Convention Center, 8:30 AM to 5:30 PM. The international event will assemble vintners, winemakers, grapegrowers, and wine scientists from respected winemaking regions around the world to encourage professional, scientific, and cultural exchange.

For more information, visit the ASEV website, www.asev.org.

American Society for Enology & Viticulture 53rd Annual Meeting

June 26-28, 2002, Oregon Convention Center, Portland, OR

Wednesday, June 26

Microbiology session and Merit Award presentation by Dr. Ralph Kunkee.

Thursday, June 27

Sessions on: composition and analysis, vine physiology, and vineyard practices with keynote speakers on viticulture and enology, and annual business meeting.

Friday, June 28

Joint session on cultural practices and wine quality; an honorary research lecture by Professor Michel Feuillat; and an experimental design workshop.

For more information: tel: 530/753-3142; fax: 530/753-3318; e-mail: society@asev.org; website: www.asev.org.

ASEV Eastern Section's 27th Annual Conference

July 10-12, Sheraton Baltimore North, Baltimore, MD

Red wine varieties for the East: Merlot, Cabernet Franc, Syrah, Chambourcin

The ASEV Eastern Section's 27th Annual Conference will focus on viticultural and enological aspects of these four red varieties whose popularity has grown in the mid-Atlantic wine region of the U.S.

Presentations will feature international experts from regions that have established a reputation for premium vinification of these varieties. Additional speakers include commercial and academic specialists who are on the cutting edge of grapegrowing and winemaking aspects of these varieties in the eastern U.S. Representative wine samples will be included when appropriate.

For more information, visit the website at: http://www.nysaes.cornell.edu/fst/asev or contact: Ellen Harkness, tel: 765/494-6704, email: harkness@foodsci.purdue.edu.

SUPPLIER SHOWCASE

Winemaking Supplies

Enzymes Yeast Yeast
Malolactic Cultures
Nutrients Fining Agents
Filter Media Oak Alternatives

LALLEMAND

Lallemand produces over 180 different yeast and malolactic bacteria cultures for the international winemaking community. For over 25 years, its commitment to research and development in the area of winemaking fermentation continues to be Lallemand's primary goal.

Yeast — for 2002, Lallemand is introducing Lalvin ICV-D21 that, unlike most wine yeast, retains higher acidity and produces higher polysaccharides in red wines. These attributes prevent the risk of developing cooked jam and alcohol burning sensations in highly mature and concentrated Cabernet Sauvignon, Merlot, and Syrah. Also new is Lalvin R-HST that was selected for its exceptional enological properties in Riesling from trials (1991 to 1996) in the Heiligenstein region of Austria.

Bacteria — Direct inoculation cultures Lalvin 41 and Enoferm Beta are new ML cultures being offered. Both cultures are the result of an extensive European Union collaboration to research natural *Oenococcus oeni* strains. Many highly regarded wineries and Oenological Institutes participated in this four-year collaboration to isolate, select, and study malolactic bacteria with unique winemaking properties.

Nutrients — New fermentation nutrients introduced last season include ML nutrients and primary fermentation nutrients, Go-Ferm and Opti-RED.

Contact Lallemand for assistance in choosing the best fermentation tools suited to your resources and stylistic goals.

For more information, contact:
Lallemand
Gordon Specht
PO Box 5512, Petaluma, CA 94955
tel: 707/526-9809; fax: 707/526-9803
e-mail: gspecht@lallemandwine.com
website: www.lallemand.com

PLEASE SEE LALLEMAND'S AD, PAGE 56.

PICKERING WINERY SUPPLY

Pickering Winery Supply distributes a special potassium caseinate, Vinpur Special, from Meggle of Germany.

Casein has long been recognized in Burgundy and Australia as an effective, gentle way of removing bitterness, brown pigments, and oxidized phenols in red and white wines. But while many winemakers in the U.S. have tried it, even more have been put off by the difficulty of the agent's application.

Meggle has solved this problem by using cellulose as a carrier that can be directly dispersed in your wine. This means that casein's excellent characteristics in the lab can be easily reproduced in the winery; a predictability that allows you to selectively target different components in your wine.

Most wineries that have tried it now look upon Vinpur-Special as more than just a problem-solver: it has become an integral part of their winemaking process.

For more information, contact:
Pickering Winery Supply
John Pickering
888 Post St., San Francisco, CA 94109
tel: 415/474-1588; fax: 415/474-1617

PLEASE SEE PICKERING WINERY SUPPLY'S ADS, PAGES 26 & 83.

SCOTT LABORATORIES, INC.

Scott Laboratories offers a wide range of winemaking supplies.

New this year for the harvest is Opti-Red® from Lallemand. Opti-Red is produced from yeast biomass harvested at the end of its growing phase. At this point, polysaccharides are more reactive than those released later during autolysis. Opti-Red is more than simply a biological nutrient for yeasts. Its use means polysaccharides are available at the beginning of maceration. This allows improved complexing of tannins and polysaccharides. The result is enhanced mouthfeel, together with improved tannins, polyphenols, and color stability.

New this year from Laffort is Tan'Cor GrandCru, which is a blend of highly polymerized and refined grape and oak tannins. It was specifically developed for use in tank and barrel aging to increase structure while helping to stabilize color and protect against oxidation. Due to the unique extraction process, Tan'Cor GrandCru enhances middle palate with the accrual of long-chain polyphenols.

This year, Scott Laboratories also began offering the Dove Insulation system. This unique system of insulation panels allows wineries to retrofit tanks with energy-efficient insulation at reasonable cost. A disproportionate amount of winery electrical costs are incurred while controlling fermentation temperatures during harvest. Dove Insulation helps control both fermentation temperatures and electrical costs.

Over a decade, Australians began shifting away from sprayed urethane to the Dove system. There are now literally thousands of energy-efficient tanks that have been retrofitted.

For more information, contact:
Scott Laboratories, Inc.
2220 Pine View Way
Petaluma, CA 94954
tel: 707/765-6666; fax: 707/765-6674
e-mail: info@scottlab.com
website: www.scottlab.com

Scott Laboratories, Ltd.
1845 Sandstone Manor, Unit 14
Pickering , ONT Canada L1W 3X9
tel: 905/839-9463; fax: 905/839-0738

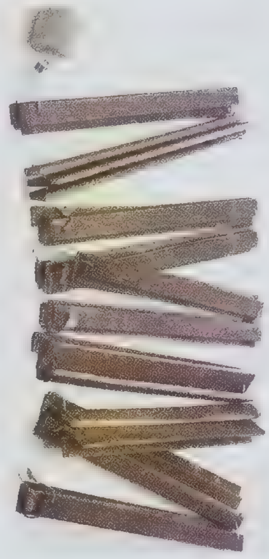
PLEASE SEE SCOTT LABORATORIES' ADS, PAGES 27 & 85.

STAVIN INCORPORATED

StaVin's premium oak integration systems deliver flavor profiles better than many traditional oak barrels.

All French, Hungarian, and American oak is seasoned for three years and available in various toast levels. During traditional fire toasting, StaVin carefully monitors thermal parameters to ensure optimal heat penetration, offering a complex range of flavors.

Full stave tank products: StaVin's Tank Matrix or Modular Tank Unit is loaded with StaVin's 44-square-foot stave packets to achieve the highest quality oak and wine integration.



Bagged tank products: Packaged in food-grade, FDA-approved nylon bags, StaVin's French Oak Segments (15-pound bags) and French, Hungarian, and American Oak Beans (10- or 20-pound bags) provide a value-added life of 12 months. During red wine fermentation, Segments and Beans are exceptional for cross-linking grape tannins that build mid-palate structure and initiate color stabilization.

Neutral barrel rejuvenation: Traditional Barrel Inserts are cooper-installed through the head, providing 150% new-barrel extraction. Barrel Oak Replicas consist of 10 three-stave sections inserted through the bunghole, yielding 100% new-barrel extraction. Both inserts are quality solutions, extending the life of your barrels.

Barrels: StaVin also represents traditional cooperages: Berthomieu and Bernard French oak barrels and Kelvin Cooperage American barrels, all two-year seasoned.

For more information, contact:
StaVin
Alan Sullivan, Stephen Sullivan,
Dr. Jeff McCord, or Jamie Zank
PO Box 1693, Sausalito, CA 94966-1693
tel: 415/331-7849; fax: 415/331-0516
e-mail: info@stavin.com

PLEASE SEE STAVIN'S AD, PAGE 17.

NAPA FERMENTATION SUPPLIES

Napa Fermentation Supplies offers a complete line of Lalvin fermentation supplies including 22 strains of wine yeast. The yeasts available are Lalvin BM45, Lalvin S6U, Lalvin D254, Lalvin CY3079, Lalvin RA17, Lalvin T73, Lalvin R2, Lalvin Zymalfore VL1, Lalvin EC1118 Prise de Mousse, Lalvin 71B, Lalvin K1, Lalvin L2056, Lalvin Wadenswil 27, Montrachet Davis 522, Champagne Davis 595, Uvaferm PM (Prise de Mousse), Uvaferm CEG (Epernay 11), Uvaferm Steinberger, Lalvin RC212, VL3, F-10, and F-5.

Malolactic cultures include X-3, OSU, Inobactor, and MT01. Yeast nutrients are Fermaid K and Fermaid 2133.

Additionally, Napa Fermentation Supplies carries a full line of winemaking equipment and supplies, including labware, refractometers, wine thieves, rubber stoppers, fermentation locks, and chemicals.

For more information, contact:
Napa Fermentation Supplies
575 Third St., Bldg. A
(Inside the Napa Town & Country Fairgrounds)
PO Box 5839, Napa, CA 94581
tel: 707/255-6372; fax: 707/255-6462

PLEASE SEE NAPA FERMENTATION'S AD, PAGE 59.

GusmerCellulo Company

Gusmer*Cellulo* Company has worked with the wine industry and offers all Chr. Hansen bacteria and nutrients, which are the preferred malolactic fermentation aids of many of the world's most successful winemakers.

If you seek fast and effective malolactic fermentations, then take advantage of the benefits of Viniflora Oenos and Viniflora CH35. These freeze-dried cultures, containing *Oenococcus Oeni* (leuconostoc oenos), are strong enough to ensure stable, and more important, reliable malolactic fermentations in both red and white wines. What makes them even more appealing is their simple and practical application — simply pour the culture directly into the wine and let nature take its course! Bactiv-Aid, a nutritional supplement developed specifically for ML bacteria, is also available.

Gusmer*Cellulo* offers the latest in winemaking enzyme technology from Novozymes, a world leader in enzyme applications, including the well-regarded Vinozyme G enzyme for premium red wine production, available throughout the season. Gusmer*Cellulo* distributes Red Star yeast and Red Star yeast nutrients.

Service with knowledge makes Gusmer*Cellulo* the perfect choice for winemakers.

For more information, contact:
Gusmer*Cellulo* Company
West Coast:
81 "M" St., Fresno, CA 93721
tel: 559/485-2692; fax: 559/485-4254
East Coast:
1165 Globe Ave., Mountainside, NJ 07092
tel: 908/301-1811; fax: 908/301-1812
e-mail: sales@gusmercellulo.com
website: www.gusmercellulo.com
PLEASE SEE GUSMERCELLULO'S AD, PAGE 28.

INNERSTAVE LLC

"Shaping the taste of fine wines" has been the most fulfilling activity at Innerstave for over 20 years. Innerstave, the originator of the barrel insert, reduces costs for oak barrel flavors.

Winemakers appreciate Innerstave because of its non-invasive, no welding, cleanable design. Little effort is required of cellar staff because Innerstave is installed for free by its own qualified coopers.

Innerstave's coopers also provide quality barrel consultation and repair and its sales staff has many creative solutions for barrel and tank problems.

Innerstave's highest acclaim is for its award-winning flavors found in wines of all price ranges, including ultra premiums.

The supply of on-site, air-dried French, American, and Oregon oaks ensures availability of high quality, prepared oak for every order. Winemakers can use Innerstave to manage and control wine-to-wood ratios, oak type, and toast levels. Most find that using Innerstave allows them to reduce winemaking variables and better predict finished wine flavors, and the use of Innerstave at any time during the wine's life gives the winemaker better control of the wine's character.

Innerstave's oak chips, called "OakPLUS," have been a flavor benchmark for oak chips used in wineries. The low-dose, high-flavor impact of these chips makes them one of the most requested chips in the industry and very cost-effective.

For winery friends who have small lots of wine or are far away from Innerstave's home in Sonoma, CA, Innerstave invented Chain O' Oak, a self-install alternative to new barrel Innerstave.

Innerstave guarantees satisfaction in everything it does!

For more information, contact:
Innerstave, llc
Bob Rogers
24200 Arnold Dr., Sonoma, CA 95476
tel: 707/996-8781; fax: 707/996-1157
e-mail: bob@innerstave.com
PLEASE SEE INNERSTAVE'S AD, PAGE 9.

VINQUIRY

Published once every two years, the Vinquiry 2002–2004 catalog is in the mail. If you're not on the mailing list, visit booth #236 at the ASEV annual meeting in Portland, OR to obtain one or submit request at www.vinquiry.com

A new active dry yeast is ENOFERM VQ11 with a new name and preparation for the yeast isolated by Vinquiry from a Williams Selyem Late Harvest Zinfandel in 1989. It has been popular as liquid yeast with strong fermentation kinetics and alcohol tolerance.

Also new is direct-addition MCW malolactic bacteria, first isolated by Vinquiry. It combines superior fermentation properties and improved sensory contribution of MCW with the convenience of direct-inoculation bacteria.

Nutrient selections include Go-Ferm, a source of bioavailable micronutrients added directly to the yeast rehydration water. Trials have shown improved slope and shorter time to dryness at the end of fermentation. Nutrients Fermaid K, Actiferm 1 & 2, Cerevit, and Oenovit are available.

Vinquiry offers more than 35 yeast isolates to make suitable matches for fermentation and wine style. Experienced, knowledgeable staff is available to assist with yeast and nutrient recommendations to optimize fermentation conditions for wine quality and to avoid stuck fermentations.

Vinquiry also offers carefully selected products from the Martin Vialatte line for premium wine production, including: tannins (Oenotan, Tanichene, and Vitanil AS, B, and VR), fining agents (Gelatin Extra, Gelisol, Albuminocol, Solugel, Cristaline, Miracol, Ovocol, and Polycase), and Efferbaktol, SO_2 in easy-to-use tablet form.

For more information, contact:
Vinquiry
7795 Bell Rd., Windsor, CA 95492
tel: 707/838-6312; fax: 707/838-1765
PLEASE SEE VINQUIRY'S AD, PAGE 47.

THE WINE LAB

Products available from The Wine Lab include: Red Star and GB yeasts, Viniflora™ oenos and CH-35 ML cultures, fermentation aids (Superfood, Leucofood, Vitamix, Leucovit); enzymes (GB Rapidase Ex-Color, CX, AR2000, Lysozyme); lab and cellar chemicals and supplies.

Services provided by The Wine Lab include: chemical and microbiological analysis; consultation, problem solving, and wine quality improvement.

The Wine Lab provides technology transfer in seminars, training sessions, technical books, and informational literature.

Chile is part of The Wine Lab's global affiliations through Vinotec S.A., providing international technology and a wide range of products:

Nutrients: The Wine Lab's proprietary nutrient and vitamin blends are available in Australia and Chile as well as the U.S. and New Zealand, to help yeast and ML fermentations go smoothly to completion. Testing juice for YAN (ammonia N + NOPA) is highly recommended to calculate supplementation levels.

Stuck ferments: The Wine Lab has worked with thousands of problem fermentations in several countries. Harvest 2001 brought more attacks on fermenting and stuck wines by aggressive *Lactobacilli*, but Inovapure lysozyme shows promise in the prevention and treatment of this problem.

Microbiology: Under Lisa Van de Water's direction, microbial spoilage has always been a specialty of The Wine Lab. Wine microbiology classes, using a new digital photomicroscope, and defect tastings are held periodically. A current project looks at sensory effects of three aromatic products of *Brettanomyces.*

For more information, contact:

The Wine Lab
U.S./Canada
110 Camino Orouga, Napa, CA 94558
tel: 707/224-7903; fax: 707/255-2019
e-mail: winelab@aol.com
New Zealand
Pacific Rim Oenology Services, Blenheim
tel: (+64-3) 577-9000; fax: (+64-3)577-9001
e-mail: pros@hortresearch.co.nz
Chile
Vinotec S.A., Santiago
tel: (+56-2) 443-1723; fax: (+56-2) 443-1724
e-mail: vinotec@entelchile.net

PLEASE SEE THE WINE LAB'S AD, PAGE 34.

WORLD COOPERAGE

World Cooperage offers alternatives to investing in new oak barrels. These cost-effective products, available in air-dried, fire-toasted French, Eastern European, American, and Chestnut oak, impart refinement and flavor of oak to your wine.

Tank Staves: World Cooperage designed its oak stave systems to practically fall in to place, without special containers or equipment. You can also choose the configuration that's best for your production: cube, triangle, or hexagon, positioned horizontally or vertically.

Barrel Renewal Systems: World Cooperage has made its barrel inserts both easy and affordable. World Cooperage's quick-install, side-wall design gives your existing barrels abundant new oak, yet it doesn't interfere with stirring, fermenting, and other winemaking techniques.

Oak Chips: Oak chips can be a flexible, cost-effective way to add elegant oak flavors to your wine. World Cooperage carefully sizes and toasts its chips for different fermentation and aging processes.

Oak Powder: New in 2000, this product was successfully launched due to its ease of use and impact during fermentation.

Bill Munroe is World Cooperage's full-time barrel alternative specialist. His in-depth understanding of these products and their application will help you find the product that best fits your winemaking.

For more information, contact:

World Cooperage
Bill Munroe
2557 Napa Valley Corp. Dr., Suite D
Napa, CA 94558
tel: 707/255-5900; fax: 707/255-5952
website: www.worldcooperage.com

PLEASE SEE WORLD COOPERAGE'S ADS, PAGES 13, 20 & 36.

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For Information Contact:
Dr. Richard Vine, Competition Director
1160 Food Science Building
Purdue University; West Lafayette, IN 47907
Phone (765) 494-6704; Fax (765) 494-7953
Email: harkness@foodsci.purdue.edu

IN ABC Authority LOA 031703

KLR MACHINES, INC.

KLR Machines, Inc., represents Begerow Co., which produces the BECO line of filtration and fining products. BECO filter products are used by many wineries throughout the U.S. More than 30 years of research and practical experience are reflected in the quality and performance of BECO products.

BECOFLOC's mechanically fibrillated structure, combined with its adsorbent quality, allows BECOFLOC to be more efficient in removing ultrafine turbidities and colloids than cellulose fibers, perlite, or diatomaceous earth. When added to other filter aids, BECOFLOC will improve their filtration efficiency.

BECO filter sheets are available in various micron retentions (nominal), allowing the winemaker to achieve desired results. BECO filter sheets are used for coarse clarification up to sterile filtration prior to bottling. The matrix of BECO filter sheets allows for a gentle filtering action that guarantees valuable wine characteristics are not lost.

BECO SIHA isinglass is a natural fining agent produced from fish bladders and sold in the form of dried sheets. In wine, isinglass has a very strong positive charge that acts to adsorb and flocculate negatively charged colloidal materials.

Begerow offers a complete line of yeast and other products used in wine treatment. Please contact KLR for your specific requirements.

For more information, contact:
KLR Machines
350 Morris St., Ste. E, Sebastopol, CA, 95472
tel: 707/823-2883; fax: 707/823-6954 or
47 West Steuben St., Bath, NY 14810
tel: 607/776-4193; fax: 607/776-9044

PLEASE SEE KLR'S AD, PAGE 00.

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PWV BOOKSHELF

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John Caldwell **56pp—$39.00**

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Manual on construction, maintenance, and use of oak barrels. User-friendly, informative text and photos. **112pp—$25.00**

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Oz Clark
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BY RHODA STEWART

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Another new addition is ZAK Cooperage, which opened this year just south of Louisville, KY. The cooperage is owned and managed by the Zimlich family, which started its stave mill on the site 12 years ago. All oak is aged, sawn, and fire-bent on the property.

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Saverglass has also created the new 2.2-lb.(1kg) Bordeaux Hermes bottle, which partners well with the exquisite La Baronne bottle with a punt larger than 2 1/2 inches (72mm).

For samples and information, please contact Erica Harrop, VP of Sales and Marketing.

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A LOOK AT ST. SUPERY 12 YEARS LATER

BY Millie Howie

Children can learn about winegrowing from a 16-page coloring book while their parents sample St. Supery wines in the tasting room.

When estimates put the number of visitors to the Napa Valley each year at over five million, it would seem that every winery tasting room would be bursting with guests. But the wine public does not ration itself out to assure an equal distribution of visitors. If you're a winery owner looking to attract newcomers and turn them into devoted fans of your wines, you must find a way to differentiate your winery from the 240 others in Napa Valley.

Some wineries, by choice, invite no guests. Others, established since 1990, cannot host the public except by appointment because of new county regulations. St. Supery (Rutherford, CA), where Michaela Rodeno has been executive vice president and CEO since November 1988, has welcomed guests since it opened in July, 1989. It has encouraged them by appealing to the love of exploration that has always characterized Americans.

Discovery set as theme

“Americans like to discover things,” Rodeno says. “They like to learn, and, if you make it interesting, they'll end up discovering your wine. Even before I joined St. Supery, Robert Skalli (owner), had added Pat Tracy to the winery staff to develop a sales and marketing program. Tracy worked alongside Didier Perrin, sent by the Skalli family from France, to take charge of winery construction.”

In assigning Tracy the task of designing a public interface for the winery, Skalli's attitude was, “Here was this family coming in from France to change the face of the land. So we wanted to demonstrate that we intended the winery to give something special back to the community.”

The “something special” turned out to be a Wine Discovery Center. Tracy realized that design would be the most important factor in creating an attractive environment for the center, so he brought in Gordon Ashby to achieve the desired effect. Ashby had designed Coyote Point Museum (San Mateo, CA), the Oakland (CA) California History Museum, and the Fromm and Sichel Wine Museum (San Francisco).

“I went to look at the property and when I saw that wonderful Queen Anne Victorian with its tower and gable roof, built in 1882 by Joseph and Louis Atkinson, original owners of the property, I asked Pat what he was thinking of doing with it,” recalls Ashby.

“At that point, there was talk of turning it into a tasting room. I had visions of restoring the old house, filling it with furniture and accessories of the period, and transforming it into a sort of living museum. I envisioned the house completely restored, with space dedicated for archival materials, a library and a director to oversee the facility.

“Earl Bouligny, the St. Helena architect who designed St. Supery, and wine historian Bill Heintz researched the history of the Atkinsons and the Dollarhide Ranch in Pope Valley, which the Skallis purchased in 1982, while I started searching for furnishings for the house. We were so successful with our restoration that the Atkinson House is now listed on the National Registry of Historic Buildings.

“We had some great photos available which could serve as a nucleus for historical panels. I suggested extending the photo history to include the entire Napa Valley, which would provide winery visitors with something more than a roadside attraction. The Skalli family was strongly attracted to the idea.”

Discovery Center takes form

The next goal was to create an educational concept basic enough to be understood by the casual winery visitor. Out of this evanescent thought grew the Wine Discovery Center, intended to answer a lot of frequently asked questions about wine and the vineyards and facilities which produce it. To the delight of all involved, the Skallis dedicated virtually the entire upper level in the main winery building to the project.

"I would come up with the ideas and present them to the Skallis," recalls Ashby. "As long as I didn't go over my budget everything was fine. Everything we did was aimed at providing the visiting public with an interactive way to investigate the various elements in winemaking without having to literally walk around the floor of a working winery.

"We cut observation windows through the walls overlooking the winery floor, wrote reader boards, and built displays. The entire space became a self-guided tour that depicted the geologic land mass, appellation areas, even the marketing of wine, through the use of photographs, models and three-dimensional graphs.

"We created a topographic relief map showing where the St. Supery vineyards are, hung an oil painting of local weather patterns on the wall, and included a map of the world with all the winegrowing regions highlighted. On one wall we installed a gallery of photos of the people who worked at the winery, tying the human element to the winemaking process."

As the project gathered momentum, Tracy and Ashby called on the talents of the artists and craftsmen Ashby had worked with in designing museums and their displays.

"It was the first time I had been involved in this sort of project," Tracy says. "It was a learning experience, literally from the ground up.

"We sat around and did a lot of brainstorming — seeking unique ways to provide visitors with interesting, easy-to-understand demonstrations of everything about wine. This included finding a way to illustrate the olfactory aspect of wine and developing a language of descriptors to help visitors understand what their noses were telling them.

"The building was up and exhibits in the as yet unfinished Wine Discovery Center had been built by the time I arrived in 1988," Rodeno says. "Everything was planned but not yet built. Only one exhibit was changed since then — one which was going to have displays of bottles and matching glassware. We tossed that idea out and put in the Smell-a-Vision interactive display."

Smell-a-Vision turned out to be the most popular feature of the Wine Discovery Center. When it was created there were no aroma concentrates on the market, so the team used natural products to get the scents they wanted. In the beginning, actual fresh fruit was used to explain the aroma of apples, pears, and other fruits, but the fruit was quick to spoil and as it spoiled the aroma would change. Decaying fruit also drew fruit flies.

With the introduction of synthetic materials it became possible to design a portable Smell-a-Vision kit, which could be utilized at trade shows and group tastings.

New additions to discovery theme

Other elements of "discovery" were part of the historical property. A Victorian rose garden has been restored as part of the landscaping for the Atkinson House. A display vineyard with examples of various styles of trellising on eight grape varieties planted in St. Supery vineyards was installed. Repeat visitors can follow the progress of vine growth from dormancy to harvest and taste grapes off the vine.

When Rodeno noticed a large number of children arriving at the winery with their parents, she arranged for design of a 10-page coloring book. Along with pictures of barrels, grape leaves and clusters, the booklet contains games to play as well as to color. There is a depiction of the Smell-a-Vision display and a drawing of the cut-away Zinfandel vine, showing roots and soil level.

When children appear in the reception area, each one receives a copy of the coloring book along with a set of four crayons. Chris Parker, Visitor Center Manager, reports the winery goes through 1,000 four-packs of crayons every year.

Events add to air of discovery

Christine Carey, special events director, maintains an events database to manage a schedule of themed tastings and special events. Most of the events are six months in the planning, particularly those which draw a crowd of 100 or more. Some events are planned a full year in advance.

"Our major events are targeted towards corporate groups, and are promoted by contacting companies directly or working with a destination management company that designs experiences for their clients," says Carey.

"We have developed five seminars, and each can be tailored to fit the group's profile. Topics range from in-depth, wine-related educational experiences to a "focus on fun" wine country theme. One of the most popular seminars we call 'Pairing for the Daring,' in which we demonstrate that you can drink red wine with fish.

"The seminar starts with a private tour of the winery, then everyone gathers under the heritage oak on the Atkinson House lawn for an exploration of some untraditional food and wine pairings.

"Some of the other seminars, such as 'Caberlot,' focus on trying to distinguish Cabernet Sauvignon from Merlot. A barrel tasting follows a walk in the display vineyard and a tour of the red wine production area. Guests may then opt to enjoy an informal tasting or a tasting with a sit-down technical session, or a three-course dinner featuring three 'mystery wines.' Those correctly identifying the wines receive a reward."

"Carey works with a group of local caterers so we can offer a range of styles and cuisines," comments Rodeno. "We also have our own in-house chef, Ron Barber, who, with his wife, Beatrice, entertain winery VIPs. Prices for the events range from $25 to $100 per person."

The winery sponsors an art show in the 1,945 sq.ft. gallery. The show changes every other month. The artist's reception is usually held as a benefit for a local non-profit.

The most vibrant and best attended of the shows is the annual December through January display of artworks created by the children in the art therapy program at Napa State Hospital. A selection of the paintings from the show is featured in the "Calendar of Children's Art" which is available for purchase until the supply runs out. Funds earned by calendar sales helps fund the art therapy program.

In the tasting room there is a $5 fee for sampling the wines, but once the fee is paid, the visitor receives a "Lifetime Tasting Pass," and has only to show the card on future visits for free tastings. The card is transferable to family or friends planning to visit St. Supery.

For those interested in sampling St. Supery library or limited production wines, a small sunroom at the back of the Atkinson House has been transformed into "The Divine Wine Room" where visitors may taste small production or rare vintages for a $10 tasting fee.

Results count

"For the first five years after the visitors center opened, we welcomed everyone, including buses," recalls Rodeno. "With experience, we learned which companies were reliable and considerate, so we have become very selective, and now accept buses only by appointment.

"After 12 years, I think we have a handle on traffic flow at the winery. Any changes we have instituted have been to even out the visitor pattern — to encourage visitors mid-week and at the slow times of the year so we can welcome them properly.

"Wine is not an easy subject for most Americans," admits Rodeno. "The fear factor does the individual no good, and doesn't sell much wine. We believe in opening the wine experience up and making it less forbidding and more fun. The long-term success of the Wine Discovery Center indicates, to me, that we took the right path." ■

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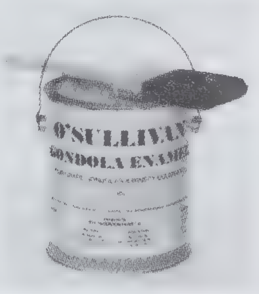

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WINERY LABORATORY QUALITY

by Sue Weeks

Getting it right — Sulfur Dioxide

(Aeration/Oxidation method)

Analysis takes on even greater importance during the critical period of bottling than it does the rest of the year. It is your last chance to ensure the continuing quality of your wine before it reaches the point of sale and is then opened by the consumer. One of the most critical analyses at this time is for sulfur dioxide.

An accurate method to measure the actual concentration (supported by quality data) is imperative. This is the time to use the Aeration Oxidation (AO) method rather than the quicker but less accurate Ripper method.

This article will discuss the AO method and provide information that will allow you to optimize your method and equipment, while ensuring that your result is as accurate as possible.

The theory

Free sulfur dioxide is removed from the wine via the aeration (air or nitrogen) of an acidified sample. The released sulfur dioxide is trapped in a hydrogen peroxide solution where it forms sulfuric acid. The acid formed is titrated with a known molarity of sodium hydroxide.

Bound sulfur dioxide is derived from the same procedure but with the addition of heat, which dissociates the bound sulfur dioxide complex. This released sulphur dioxide is trapped and titrated in the same manner. The calculation of total sulfur dioxide can be determined by the addition of the bound and free fractions.

Preparing a standard

A standard is a good way to make sure that the system is providing accurate results. If you have an accurate balance, making a standard is simple. Accurately weigh 1.50 g analytical reagent grade (AR) sodium metabisulphite ($Na_2S_2O_5$) into a 100 ml volumetric flask and make up to volume with distilled water at 68ºF. 1 ml of this solution will contain 10.1 mg SO_2.

Add to separate 100 ml volumetric flasks 0.50 ml and 1.00 ml of the standard solution using an A-grade volumetric pipette or a micro-pipette and make to volume with distilled water to give standard solutions of approximately 50 and 100 mg/L SO_2, respectively. *(Please note that this solution will have a limited shelf life and would not maintain a stable level of SO_2 for more than a few hours at most).*

You can also add this stock solution to wine. After measuring the initial SO_2* concentration, you can calculate the recovery of the spike very simply by subtracting the initial result and comparing the actual result with the expected result. This can also be expressed as a percentage where:

$$\frac{\text{Actual result}}{\text{Expected result}} \times 100 = \text{percent recovery}$$

Acceptance criteria

The next and perhaps more important question is: What constitutes an acceptable standard recovery for this analysis and this concentration? Acceptance criteria should be determined in conjunction with the winemaker, and it should consider the limitations of the analysis.

You might also wish to consider a two-step system of acceptance criteria. Why? If you have a lower level of SO_2 in the sample, a criterion that specifies a percentage (say 5%) may be very difficult to achieve. For example, a result of 10 mg/L would require a duplicate result of +/– 0.5 mg/L which is clearly outside the capabilities of the analysis. At the lower levels, perhaps below 60 mg/L, consider a mg/L criteria such as +/– 3 mg/L.

What can go wrong?

O.K., so you have analyzed a standard and have found that the results do not measure up to your acceptance criteria. Where do you go from here?

As the method involves reagents, apparatus, and operators, there are many opportunities to introduce errors into the analysis. The errors usually fall into two categories: random and systematic. A random error is one that usually occurs as a one of a kind and frequently is traceable to the operator or to temporary equipment failure (such as a burner going out). These errors are often easy to identify and fix.

Systematic errors are more frustrating because it can be difficult to identify the cause. Systematic errors will also give precise results; that is, the error is repeatable over multiple analyses of the sample, which does not relate to the actual accuracy of the analysis or the result.

The list below identifies potential sources of both random and systematic errors that can occur during the analysis. While many potential sources of error are obvious, there are a few which are not often considered when searching for a solution.

Random errors

- No sample in flask
- Wrong amount of sample in flask
- No acid in flask
- No aspiration
- No flame
- Sample over-titrated
- Sample titrated past burette scale
- No water flow through condenser (note that this is important for both free and total measurements)
- Condenser water temperature too high (water temperature should be lower than ambient for effective condensation of the sample)
- Air leak in the system
- Calculation mistake
- Dirty apparatus
- Insufficient aspiration time (less than 10–12 minutes)

Systematic errors:

- Contaminated reagents
- Contaminated water
- Incorrect flow rate (flow rate should be around 1 Liter per minute)

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* *It is not feasible to measure free SO_2 using this method, since the amount that would remain as free SO_2 in the sample cannot be determined with any accuracy.*

- Incorrectly prepared reagents
- Old reagents
- Inaccurate pipette or burette
- Molarity of NaOH not calculated

If the standard recovery is acceptable, but the result for the sample is unexpected, it may be time to commence investigations in the cellar. An error of this nature often has far greater ramifications than an error in the laboratory, which might explain a winemaker's reluctance to accept that the laboratory result is correct! For example:

Sources of error in the cellar:

- Wrong tank sampled
- Wrong material used for addition
- Contaminated addition material
- Addition incorrectly calculated
- Addition incorrectly weighed
- Tank not sufficiently mixed
- Addition made to wrong tank

Conclusion

The analysis of sulfur dioxide can be the source of much frustration, particularly in light of the number of potential problems that can and do occur. Taking full advantage of the quality tools (such as standards and spikes) that are available will help prevent these problems or make them easy to identify and solve. ■

Next issue: *Getting it right: Harvest Measurements*

Sue Weeks is an Australian wine laboratory consultant. She provides assistance in areas of formal or informal quality system implementation, method validation and troubleshooting, laboratory setup, personnel selection, and staff training. She also facilitates international wine industry training in conjunction with the Communicating for Agricultural Exchange Program (CAEP). She visits America often and can be contacted through the Bibber International website at www.bibber.com.au or tel: 61 8-8563-2422 or fax: 61 8-8563-2433. She can also be contacted through Gordon Burns at ETS Laboratories at tel: 707/963-4806.

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IN THE CELLAR *by Jake Lorenzo*

A fat one down the middle

Dr. Iggy Calamari and I were sitting on my porch sipping a rather delightful Rhône. I had a .38 snub nose. Iggy held a 9mm automatic in his lap.

"The bastards are going to kill everything," I said. "They've got no conscience, no moral imperative. They're prehistoric in their outlook, and they'll never change. Killing is too good for them."

"I don't know," mused Iggy. "There's something to be said for knowing your enemy, getting inside his skin so to speak."

I thought I saw some movement. I slowly raised my gun, braced my arm, carefully sighted down the barrel, and squeezed off a round. "I'll be damned if I'm getting inside the skin of some damn gopher," I shouted. "And the moles are even worse."

"Perhaps if Jakelyn's mother hadn't done such a wonderful job with the garden..." Iggy suggested. "I mean, it's a veritable Garden of Eden in here. Looks like you've been here for years. Can't you live and let live?"

Jake Lorenzo shook his head. "What's wrong with you, Calamari? These rodents kill a few more of Jakelyn's mother's plants and neither one of us will be left alive." I fired two quick rounds at some movement over by the newly sprouted tulips. "You better start using that gun, or she'll throw your butt out of the Garden of Eden and onto Highway 12 at rush hour."

Jake Lorenzo always gets a little testy in between false spring and true spring. I think it's the fact that the only sports going on right now are professional basketball and ice hockey. At least ice hockey made sense when it was in Canada and the northern tier of the states. I mean, they had all of that snow anyway, might as well do something with it. But ice hockey in California, Arizona, Texas? Come on! And the only thing more futile than regular season professional basketball is a winery sales consultant during boom times.

Yes sir, March Madness can't come soon enough for Jake Lorenzo. The Final Four is one of his favorite sporting events. Why? Because as soon as it's over, baseball season starts.

If you have any true wine business in your soul, then you are a baseball fan. The entire season coincides with the harvest cycle. Spring training starts just as the vines start sprouting. The real season starts at bud break. By July there are front-runners, and everyone thinks they know what will happen, but usually they're wrong. (It's the same as people offering vintage predictions in the summer.) The pennant races and the post-season come during harvest.

I remember the World Series by vintage. The 1977 season was my first in Sonoma. I sat hand-stemming Old Hill Ranch Zinfandel while listening to the Yankee-Dodger series.

No wine person will ever forget 1989. It was the year from hell; rained forever. The year Tracy Toovey was murdered. The "earthquake series." But it was also the year you had to pick a side. You were either for the Giants or the A's, one or the other, National League or American League. Jake Lorenzo is National League all the way. You can take the designated hitter and stick it with White Zinfandel.

Remember 1996? It brought a fat, ripe, high-alcohol vintage and a great, emotional series — Joe Torre's first as Yankee manager. Just a year earlier he'd been in my garage helping me label Guerrilla Vino. Then, with his brother in the hospital, he lost the first two games at home, only to bring his team back to kill off the Braves.

This last year was historical. Harvest took off like a prairie fire. Grapes were coming early and in torrents. Then came September 11, and everything seemed to stop. Sugars stuck; the weather turned cold. Grapes just hung as if in mourning. When the harvest dragged to its conclusion, we were able to focus on one of the most improbable and exciting post-seasons ever. Joe's resilient Yankees came back time after time, until Randy Johnson and Curt Schilling finally stopped them.

Wine and baseball go hand in hand. More than most things in American life, they both reflect a daily, ongoing, pastoral cycle. Each year means you have to start over. Each vintage you have to do it again. In both endeavors, a lot of individual effort needs to blend into teamwork to achieve success. And both wine and baseball need to restrain their greed to let their true spirit shine through.

The wine business has always been cyclical, and we have just finished the longest, biggest, most exhilarating upswing of Jake Lorenzo's lifetime. Grape and wine prices escalated exponentially, and everyone tried to jump onto the bandwagon. Anyone with two or three acres to spare planted grapes. Anyone with grapes started a winery. Every medium-quality bottle, it seemed, had a $50 price tag.

Well, the dam has broke, the balloon has popped, the bubble has burst. Choose your cliché. All of those rookie farmers with their two- and three-acre vineyards are going to have a hell of a time convincing some winery to buy their grapes. Grape prices are going down, because there's no sense in buying what you can't sell. Most wineries won't be taking orders for their allocations this year. Someone is going to have to get out there and sell the stuff.

Marketing and programming will make a comeback. There will be more dollars and kickbacks and payoffs floating around the wine business than sunflower seeds in the Yankee dugout. One on 10: in your dreams. One on five: just gets you in the door. Hard times are a comin', like a Randy Johnson fastball in the bottom of the ninth.

In any disaster, there are those who get reamed and those who are spared. Every shift in the economy bankrupts some, but enriches others. In the wine business, the tables are turning. The consumer is about to have his day in the sun.

Jake Lorenzo has an idea. How about making fine wine at a fair price? That's right, get over yourself. Take those Rhone Rangers and run 'em out of town. Then blend up all those Rhône varietals and give me something for $10.

Tell those Italian Super-Tuscan imitators to take all that thin, acidic Sangiovese and blend it with some Cabernet until they can give me an $8 wonder. Wasn't Chianti supposed to be wine for the people?

Take the price of your Zin back down to $15 and try to keep the alcohol below 16%. If I want port, I'll let you know.

And just to show you I'm willing to help out, I'll give you this sales lead for free. Take all that Chardonnay and Merlot you can't sell and give it to major league baseball. Let them sell it at the parks for $3 a glass instead of that stuff that comes in boxes. Use it as a public relations ploy. Let people see that wine should be an everyday sort of thing. Teach baseball fans that wine actually tastes good, and you'll be building yourself a future market. They could be the very consumers who turn the wine tide back in your direction.

But then, again, what do I know? I'm just a private eye sitting on my porch with my old friend Dr. Iggy Calamari. I'm feeling a lot better though, because Iggy just showed me something. He took one of his wine-powered pacemakers and stuck it down a gopher hole. He turned on the sprinklers and watered the yard for 10 minutes. Then he charged up that pacemaker with a bottle of Sonoma Mountain Cabernet. I thought I could hear the gophers screaming.

Spring is almost here. The gophers are on the run. Wine prices should be coming down (though it won't happen fast enough for Jake Lorenzo). On top of that, it's baseball season. Life is good.

Batter up. ■

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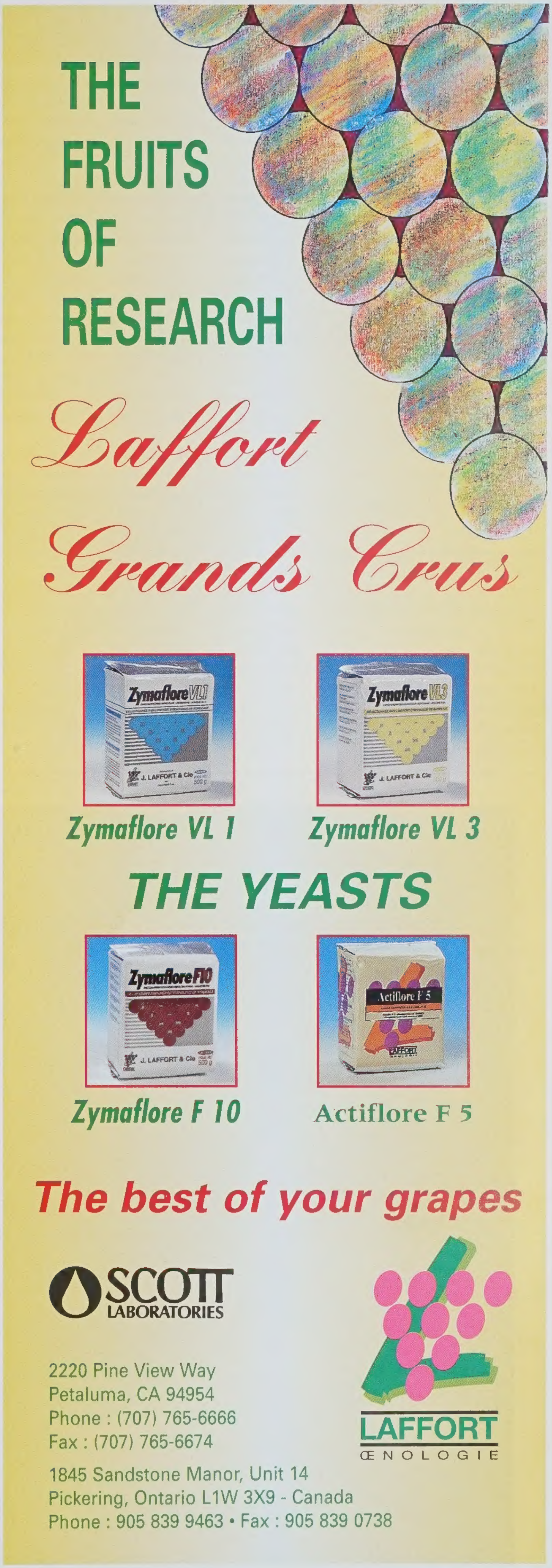

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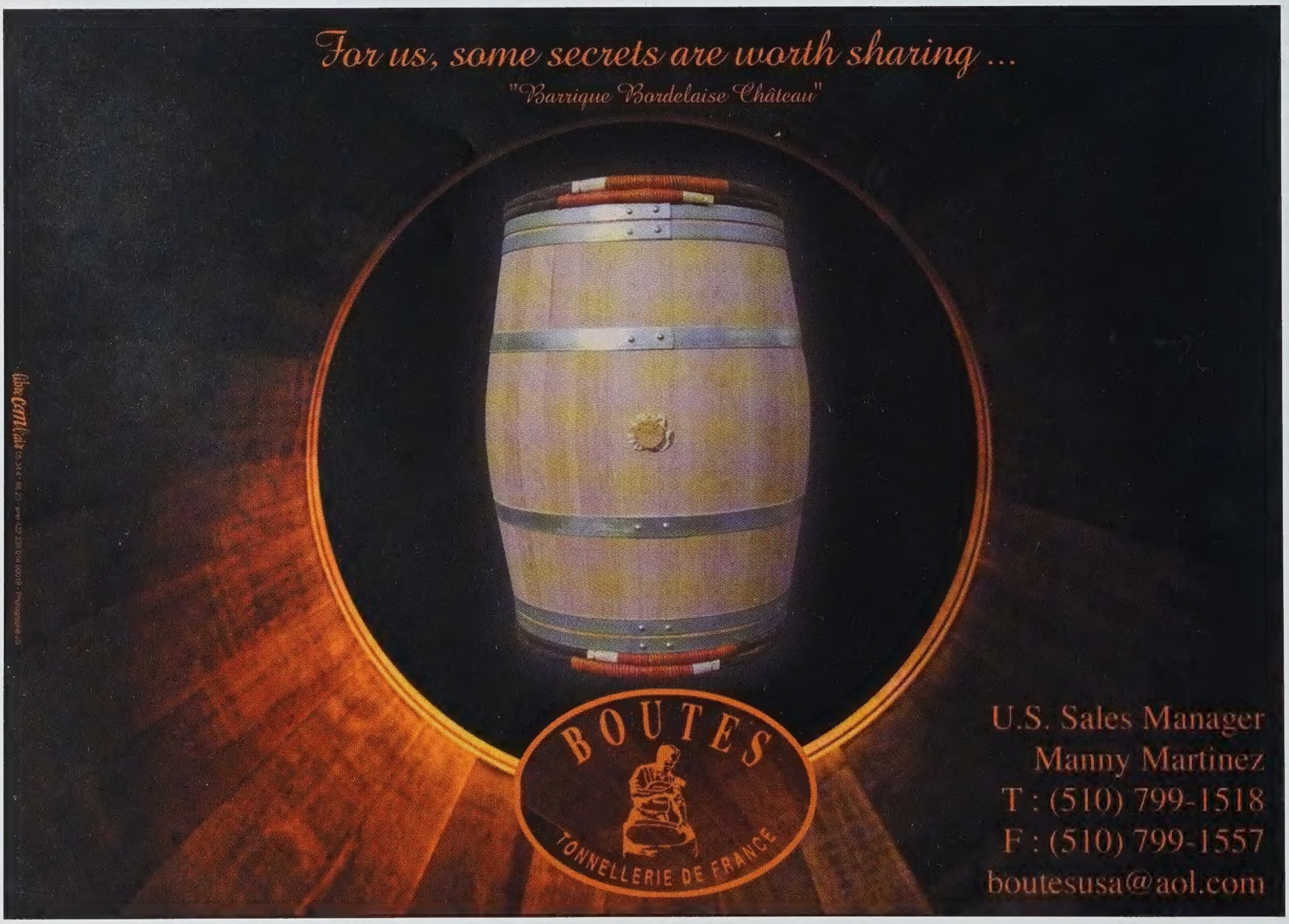
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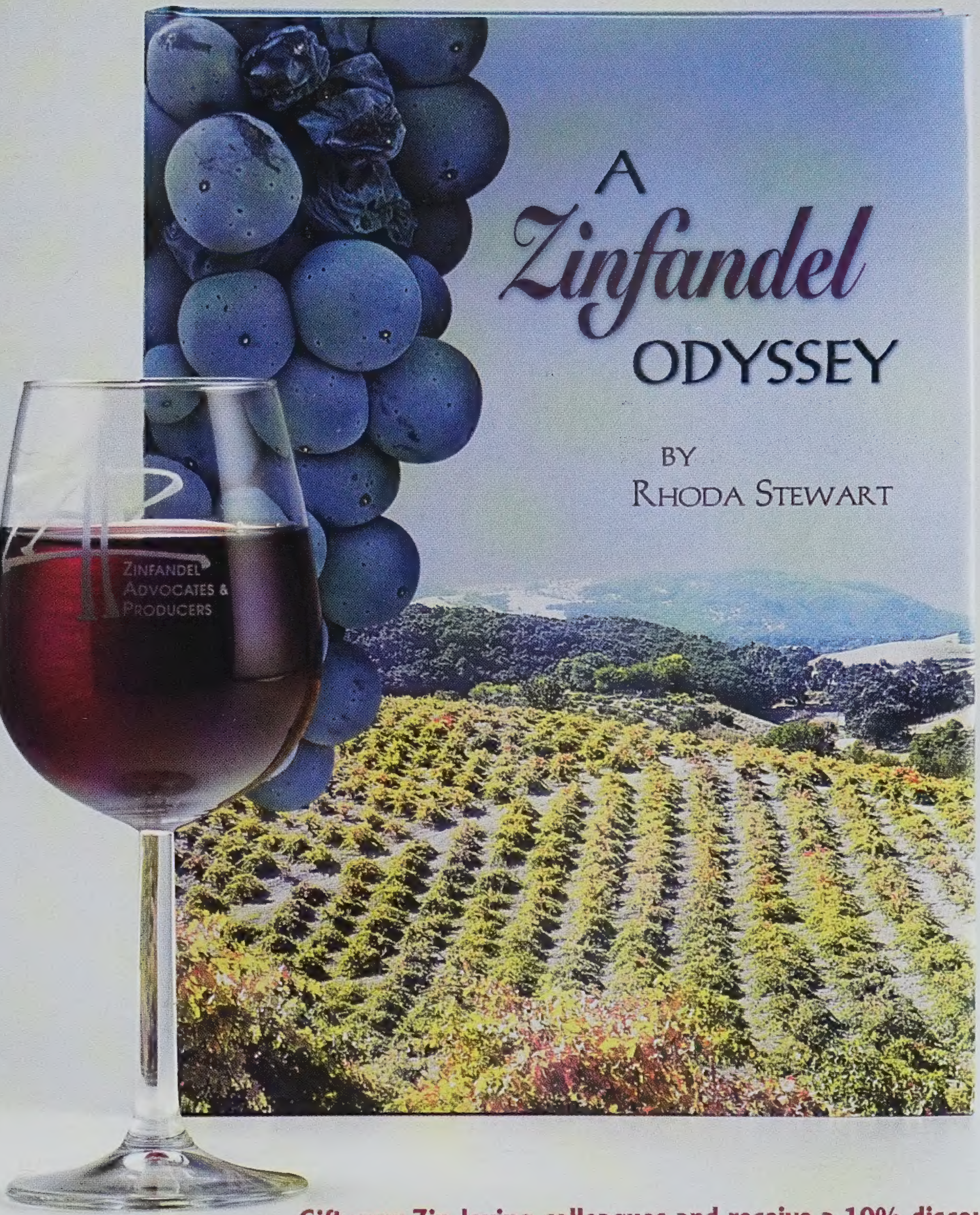

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